USING RELATIVE PHYSICIAN
EFFORT TO IDENTIFY
MISPRICED PROCEDURES

FINAL REPORT

September 1988

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1.0 EXECUTIVE SUMMARY

1.1 Objectives of the Study

Critics have argued that the current method of Medicare reimbursement "overpays" certain surgical procedures (CBO, 1986; OTA, 1986). Coronary artery bypass graft (CABG) and cataract surgery are often cited as examples. Technological improvements and greater experience have reduced the time and effort required by surgeons to perform these operations. The "usual, customary, and reasonable" (UCR) method used by Medicare and many private insurors, however, provides no mechanism for readjusting physician payment rates to reflect the greater ease of performance. At the same time, other critics have argued that certain non-surgical services, like office and hospital visits, may be paid too little (Hsiao and Stason, 1979; Hsiao, *et al*., 1985). Based on these concerns, Congress has already begun to reduce Medicare payment levels for selected surgical operations and to increase reimbursements for primary care services (Omnibus Budget Reconciliation Act of 1987).

The question remains, however: how do we identify which procedures are "overpaid" and which are "underpaid"? One way involves indexing other procedures and services to an "appropriately paid" procedure in terms of time and complexity (Mitchell, *et al*., 1987a). Which procedure is considered appropriately paid is certainly debatable, and the results appear to be quite sensitive to the choice of the "index procedure."

Another way is to quantify the existing relationship between physician effort (time and complexity) and average payments for a wide range of services. If many services are paid appropriately relative to level of effort, then a regression model that uses physician effort to explain actual payments should have good explanatory power and should identify the "outliers", or "mispriced" procedures. Although the use of fee regressions cannot be used to affirm absolute price levels, examining relative levels is an important first step in adjusting payments within the existing payment system, nonetheless.

This report seeks to identify mispriced procedures, using a unique data source: self-reported estimates of procedure time and complexity from a 1987 national survey of physicians. This report addresses the following questions:

- Are physicians able to reliably report the time it takes to perform a given procedure? Can they reliably rank the complexity of those procedures?
- Do the time and complexity estimates have face validity? That is, do the estimates make medical sense?

- What is the time-complexity-price relationship, based on a regression methodology?
- What kinds of services appear to be over and underpaid relative to the physician effort involved?
- How sensitive are our results to the specification used to identify mispriced procedures?

1.2 Related Research

Our study has drawn in large part upon the pioneering work of Hsiao, Stason, and colleagues at the Harvard School of Public Health. They have sought to analyze the potential inequities in reimbursement for surgery versus other services, by comparing the actual resource costs involved in providing each procedure. Hsiao and Stason (1979) defined the Resource-Based Relative Value Scale (RBRVS) as the combination of the following four inputs:

(1) Time - including not only the time to perform the procedure itself but also the time associated with pre- and postoperative care.

(2) Complexity - an estimate of the diagnostic and technical skills required to perform the procedure, the physical and mental intensity of the effort, and the degree of stress due to risk to the patient.

(3) Opportunity costs of specialty training - the amortized value of the opportunity costs associated with residency.

(4) Physician practice costs - including malpractice premiums as well as rent, wages, equipment, etc.

This original developmental work on the RBRVS was extended in a second study by Hsiao *et al.*, (1985) to include a wider range of procedures and data from a larger sample of physicians. Estimates of time and complexity for approximately 100 procedures were obtained from 110 Massachusetts physicians, and then validated through a modified Delphi survey of the participants and representatives from specialty boards. Practice costs and opportunity costs of specialty training were obtained from secondary sources.

Time estimates in the first study included actual procedure times obtained from hospital operating room logs in the SOSSUS study, while time estimates in the second study were self-reported. The latter, of course, have an element of subjectivity and also have the potential for self-serving manipulation. Both of the initial RBRVS studies involved face-to-face interviews with physicians.

Efforts were made in both studies to obtain estimates of complexity that were independent of the time required to perform a service or procedure; that is, the complexity per unit of time. It is difficult for physicians to keep

time and complexity dimensions separate, however, and the two may, in fact, be highly correlated. Procedures that are more complex per unit of time often do take longer. Moreover, fatigue that develops during longer procedures increases their level of complexity (physical or mental intensity). Concern over whether or not it was possible to obtain truly independent measures of complexity led Hsiao in his second study to ask physicians to also provide global measures of effort that combined time and complexity.

The development of better techniques to measure complexity is one of the major objectives of a national RBRVS study that is being conducted currently by Dr. Hsiao. The current Hsiao study gathers estimates of five dimensions of "work" involved in performing selected procedures: (1) overall rating of work, including total time and effort; (2) technical skill and physical effort; (3) mental effort and judgment; (4) concern about iatrogenic risk; and (5) summary rating of complexity based on (2), (3), and (4) combined. Data on self-reported times are also being collected. A second major objective of this study is to develop methods by which to extrapolate from the limited number of procedures and services that can reasonably be examined empirically to the universe of procedures. This is critical if the RBRVS is to serve as a foundation for a fee schedule covering all 8,000 CPT-4 codes.

Our previous work on "overpriced procedures" (Mitchell et al., 1987a) indicated percentage changes in payments for a limited number of surgical procedures that were suggested by comparing 1984 reasonable Medicare charges to RBRVS values calculated by Dr. Hsiao in his 1985 Massachusetts study. That study focused only on discrepancies within surgery (cholecystectomy was selected as the index procedure) in order to avoid the controversy that surrounds comparisons between procedural and nonprocedural services. The present study permits validation of these findings by examining the relationship between charges and time and complexity estimates from a much larger sample of physicians. It also extends these findings to a much larger number of surgical procedures and to a variety of other types of services, like visits and x-rays.

1.3 Summary of Findings

This analysis is based on a unique data base, the 1987 Physicians' Practice Follow-up Survey, which gathered data from 2,499 physicians on the time and complexity involved in performing 139 medical and surgical procedures/services. In addition, data on current Medicare allowed charges were obtained from the 1985 BMAD beneficiary file, containing the universe of claims submitted by a 5 percent random sample of Medicare beneficiaries for calendar year 1985. We performed multiple regression analysis to determine

the relationship between time and complexity and physician charges. The regressions have been performed for medical and surgical specialists separately under the assumption that the scaling for complexity differs across the two specialty groups. The medical specialty group includes: general and family practitioners, internists, cardiologists, gastroenterologists, dermatologists, neurologists, and radiologists. The surgical specialty group includes: general surgeons, cardiovascular/thoracic surgeons, orthopedic surgeons, OB-GYNs, ophthalmologists, urologists, neurosurgeons, otolaryngology, and plastic surgeons.

Predicted payment amounts were derived from the regression equations and were compared to current Medicare charges to identify mispriced procedures. The reader is referred to chapter 2 for a complete discussion of the questionnaire and data preparation techniques, and to chapter 4 for a comprehensive description of the regression methodology.

A number of different regression equations were estimated, each of which is described fully in chapter 4 and predicted amounts are presented in chapter 5. In this executive summary, we present results from the two specifications that we believe have the greatest explanatory power and validity. The first equation estimated the relationship between procedure time, pre/post time, and complexity. A surgical adjustment was included in the second regression, to reflect historic payment differentials for surgery that may result from broader insurance coverage, training requirements, or other factors. The explanatory power of the regression equations was uniformly high, although the surgeons' equations had higher R-squares than the medical specialist equations. Time and complexity explained 65 percent of the variance within physician fees in the medical equation and 79 percent in the surgical equation. With the addition of the surgical adjustment, the R-square rose to .86 and .91 in the medical and surgical equations respectively.

1.3.1 Predicted Medicare Payments for Surgical Specialists

Table 1-1 compares actual 1985 Medicare payments for 20 procedures commonly performed by surgical specialists with predicted payments based on procedure time, pre/post operative time, and complexity (col. 2). These procedures and services cover most specialties and highlight both short and long, complex and simple activities. The 95 percent confidence limits are shown beneath each predicted payment. (The predicted payments do not lie precisely between the upper and lower confidence limits due to the log-normal distribution of the charge data.) Column 3 makes similar comparisons, but here predicted payments have been based not only on time and complexity, but also on the surgical adjustment. Actual payments that are substantially above

TABLE 1-1

ACTUAL AND PREDICTED 1985 MEDICARE ALLOWED CHARGES FOR SURGICAL SPECIALISTS[a]

Description	Actual Allowed Charge	Predicted Amount without Surgical Adj.	Predicted Amount with Surgical Adj.
Adjacent tissue transfer: eyelids, nose, ears and/or lips	$524	$876 ($694-$1,104)	$815 ($681-$976)
Total hip replacement	2,252	2,080 (1,643-2,634)	1,769 (1,474-2,124)
Secondary hip revision	2,271	3,189 (2,399-4,239)	2,686 (2,155-3,349)
Total knee replacement	2,196	2,034 (1,641-2,522)	1,827 (1,546-2,158)
Permanent transvenous pacemaker insertion; ventricular	1,058	734 (518-1,038)	632 (483-827)
Coronary artery bypass; three grafts	3,714	3,228 (2,348-4,437)	2,575 (2,011-3,297)
Carotid thromboendarterectomy	1,497	1,739 (1,392-2,172)	1,634 (1,375-1,941)
Cholecystectomy	798	1,308 (1,061-1,612)	1,239 (1,053-1,458)
Cystourethroscopy with resection of small bladder tumor	322	132 (106-163)	212 (169-265)
Transurethral resection of the prostate	1,038	1,040 (839-1,288)	959 (812-1,133)
Biopsy of cervix (cone)	264	54 (44-65)	87 (70-102)
Total hysterectomy	922	1,325 (1,070-1,640)	1,182 (1,002-1,394)
Craniectomy for excision of brain tumor	2,098	4,344 (3,249-5,809)	3,620 (2,886-4,54[illegible])
Extraction of lens; extracapsular	978	1,188 (860-1,641)	1,126 (876-1,447)
Extracapsular cataract removal with insertion of intraocular lens prosthesis (one stage procedure)	1,546	1,391 (1,007-1,921)	1,333 (1,038-1,714)
Tympanoplasty without mastoidectomy	1,135	894 (663-1,205)	798 (633-1,007)
Ophthalmic ultrasound; A-mode	133	86 (68-110)	53 (43-65)
Initial comprehensive office visit for general surgeon	38	130 (105-161)	69 (56-85)
Initial comprehensive hospital visit for general surgeon	51	147 (116-186)	79 (63-98)
Swan-Ganz catheterization	245	70 (59-84)	115 (94-102)

[a] 95 percent confidence limits in parentheses.

Note: Predicted amounts do not include any downward adjustment that may be necessary in order to preserve budget neutrality, or constant total outlays across all services and procedures.

Source: Data shown here were obtained from the 1987 Physicians' Practice Follow-up Survey.

the predicted payment imply that this service or procedure is "overpaid" relative to the physician effort involved, particularly if it is also above the upper confidence limit. Where current reimbursement levels are below predicted payments (and below the lower confidence limit), we can infer that the service or procedure is potentially "underpaid".

Based on a time and complexity adjustment alone, office and hospital visit reimbursement for general surgeons would more or less triple, which is consistent with the relatively high time and complexity estimates assigned to these services. Consider, for example, the initial office visit and a cystourethroscopy with resection of a small bladder tumor. Both are reported to be of equal complexity and to take equal amounts of time to perform, yet Medicare currently pays 8 1/2 times more for this surgical procedure than for the visit. Based on the physician effort involved, however, both services would be reimbursed about the same ($130).

Interestingly, it is not only the two types of visits that appear "underpaid". Based on their relative time and complexity alone, predicted payments would be higher than current rates for several surgical procedures as well: adjacent tissue transfer, cholecystectomy, total hysterectomy, and craniectomy with excision of brain tumor.

By contrast, five of the surgical procedures shown on Table 1-1 appear substantially "overpaid": pacemaker insertion, cystourethroscopy with bladder tumor resection, biopsy of cervix, ophthalmic ultrasound, and Swan-Ganz catheterization. All of these are relatively uncomplicated and (with the exception of pacemaker insertion) take relatively little time to perform.

What impact does the inclusion of the surgical adjustment make in these predicted payments? As expected, predicted payments for non-surgical services fall, although visits still appear "underpaid" by 50-80 percent. While predicted payments for relatively simple invasive procedures like biopsies increase, those for longer operating room procedures (e.g., CABGs) actually decline. This occurs because the predicting equation places a relatively lower weight on the surgeon's time, especially for pre and post-operative care, after adjusting for the 2.8 across-the-board multiplier favoring surgical fees. At the same time, the 95 percent confidence limits associated with all the predicted payments narrow considerably. The net effect is to produce four additional "overpaid" surgical procedures: total hip replacement, total knee replacement, CABG surgery, and tympanoplasty.

Inclusion of the surgical adjustment in the predicting equation thus has the counter-intuitive result of identifying more "outlier" surgical procedures. Given the more precise and more reliable estimates produced by this equation (as evidenced by the narrower confidence band), however, these results are preferred.

The predicted payments on Table 1-1 permit some interesting observations about current Medicare fees for surgical procedures compared to their relative difficulty as perceived by surgeons. For example, Medicare reimburses about the same amount for an original hip replacement as for a revision, but the latter is considerably more complicated and time-consuming. Relative payment amounts would fall for the original replacement but rise substantially for revisions.

By contrast, Medicare currently pays almost 60 percent more for lens extraction plus intraocular lens insertion than for the extraction alone. Yet ophthalmologists report that operating time for the one-stage procedure is only slightly longer and moderately more complex. Based on the physician effort involved, the one-stage procedure would still be paid more than extraction alone, but only 18 percent more.

1.3.2 Predicted Payments for Medical Specialists and Radiologists

Table 1-2 presents similar findings for services performed by medical specialists and radiologists. Given their greater precision and reliability, we will focus here on predicted payments with the surgical adjustment. As was found with the surgical specialists, office and hospital visits appear considerably "underpaid"; predicted payments for internists' initial office visits, for example, are 39 percent higher than current payment levels. Comprehensive consultations provided by internists, on the other hand, appear to be appropriately reimbursed given the physician effort involved. Based on their self-reports, internists estimate that initial hospital visits (not shown in table) and consultations involve comparable levels of time and complexity, yet Medicare currently pays 44 percent more for the latter ($85 versus $59).

Four common diagnostic procedures appear considerably "overpaid": skull x-ray, upper GI endoscopy (both diagnostic only and with biopsy), echocardiography, and cardiac catheterization with angiography (both combined right and left heart, and left heart only). Predicted payments for these procedures are about 50 percent lower than current Medicare payment levels. By contrast, current reimbursement rates for other common, but more routine, services such as ECGs, EEGs, and chest x-rays appear to be equitably paid relative to the physician effort involved.

1.3.3 Implications for Over and Underpaid Physician Services

Our results have shown that the majority of the variation in Medicare payment can be explained by the physician effort associated with providing different services and procedures--particularly if a special allowance is made

TABLE 1-2

ACTUAL AND PREDICTED 1985 MEDICARE ALLOWED CHARGES FOR MEDICAL SPECIALISTS AND RADIOLOGISTS[a]

Description	Actual Allowed Charge	Predicted Amount without Surgical Adj.	Predicted Amount with Surgical Adj.
Skin biopsy	$40	$47 ($38-$60)	$84 ($64-$111)
Excision of benign lesion, trunk, arms, or legs; lesion 1.1 to 2.0 cm	66	81 (70-95)	140 (111-176)
Diagnostic upper GI endoscopy	279	86 (72-102)	142 (113-179)
Upper GI endoscopy with biopsy	323	97 (80-116)	156 (124-197)
Complete skull x-rays, interpretation and report	22	18 (13-24)	15 (12-19)
Chest X-ray, single view, interpretation and report	13	14 (9-19)	12 (9-16)
Chest X-ray, two views, interpretation and report	14	16 (11-22)	14 (10-18)
Upper GI series interpretation and report	30	34 (28-42)	27 (23-32)
Cholecystography, oral contrast; interpretation and report	19	18 (13-25)	17 (13-22)
Initial comprehensive office visit for general practitioner	40	95 (79-113)	65 (55-76)
Initial comprehensive office visit for internist	61	130 (106-159)	85 (70-102)
Initial comprehensive office visit for cardiologist	65	119 (95-150)	81 (66-99)
Follow-up intermediate office visit for internist	25	46 (36-59)	37 (31-45)
Initial comprehensive hospital visit for cardiologist	68	125 (101-154)	83 (68-100)
Initial comprehensive consultation for internist	85	151 (123-185)	94 (77-115)
ECG interpretation and report	13	17 (13-23)	15 (12-19)
Echocardiography, real time	96	79 (67-94)	53 (45-62)
Combined left heart catheterization with angiography	606	183 (139-240)	258 (200-333)
Combined right and left heart catheterization with angiography	813	246 (182-331)	334 (256-435)
EEG (awake, asleep, and drowsy) interpretation and report	39	50 (39-66)	34 (28-43)

[a] 95 percent confidence limits in parentheses.

Note: Predicted amounts do not include any downward adjustment that may be necessary in order to preserve budget neutrality, or constant total outlays across all services and procedures.

Source: Data shown here were obtained from the 1987 Physicians' Practice Follow-up Survey.

for surgery. This implies that _relative_ fee differences are less distorted than commonly thought. That is, the fact that thoracic surgeons are paid more for CABGs than general surgeons are for hysterectomies can be largely explained by the greater time and complexity of bypass surgery. Similarly, based on surgeons' self-reports, higher payments for surgery than for visits can be justified by the more intense effort involved.

Nevertheless, a number of services and procedures have been identified that appear to be "under" or "overpaid". CABG surgery is currently paid almost 100 times more than a general surgeon's comprehensive office visit, but, based on the relative time and complexity of these two services, the difference should be "only" 37-to-one. This, of course, is consistent with the criticism of many observers that Medicare "underpays" for non-procedural (the so-called cognitive) services.

Congress has reduced the Medicare prevailing charges for a number of surgical procedures believed to be "overpaid", including some also identified by our regression methodology: coronary artery bypass surgery, pacemaker insertion, total hip and knee replacements, and upper GI endoscopy. When these procedures were first developed, their high fees may well have been appropriate given their newness and surgeons' inexperience with them. Over time, technological advances and "learning by doing" undoubtedly have made them easier and quicker to perform, yet fees have remained high (Bowen, 1987; Mitchell, _et al_., 1987b). Indeed, since the UCR method of reimbursement bases payments on submitted charges, the incentive has been to continually increase fees rather than to lower them.

Based on reported physician effort, however, other procedures that also were rolled back by Congress do not appear "overpaid" in relation to time and complexity. These include cataract surgery and prostatectomy, whose actual allowed charges fell within the confidence limits of our predictions, albeit still roughly ten percent above their expected amounts. The reason appears to lie primarily in the relatively long pre and postoperative times reported for these operations. Ophthalmologists report that lens procedures require relatively little time in the operating room (less than one hour), but that they spend almost three times as long in preoperative and follow-up care. In the regressions that included only operating time, both cataract surgery and prostatectomies appeared considerably "overpaid". Since surgeons report that their pre and postoperative care is usually part of their global fee, however, it must be considered as part of the total effort associated with a procedure. Yet, the Congress considered only operating room times in justifying payment reductions. Future deliberations on fee rollbacks should consider any extraordinary time involved in pre and postoperative care, but our results indicate that non-operating time is valued at only one-third the

rate of procedure time. And because non-operating time plays such an important role in explaining allowed charges, it will be crucial to measure such time input as accurately as possible, as well as the extent to which this time remains bundled in the global surgical fee.

Of course, other factors might affect fees besides the complexity of the procedure and the time it takes to perform and to provide follow-up care. Visits, for example, may involve more non-physician time, and this effort was not included in our regression methodology. To the extent that office visits require more nurse or aide time, as well as other overhead inputs, they will be even more underpaid relative to operations. Even among surgical procedures, practice costs may differ. General surgeons and gynecologists performing hysterectomies, for example, face higher malpractice premiums than do ophthalmologists doing lens extractions, yet predicted payments based on time and complexity are comparable for both operations.

A broader question than whether a few surgical procedures are overpriced is whether surgery in general is overpriced. Our results indicate that surgical procedures are 2 1/2 to 3 times more expensive than medical services of equivalent time and complexity. Patient willingness to pay more for surgical intervention, longer training residencies, and higher malpractice costs may all be legitimate explanations for this surgery payment premium. On the other hand, any insurance bias in favor of surgery may have distorted fees in ways that are neither efficient nor equitable. How one evaluates this large unexplained surgical differential would have profound implications for the number of overpriced surgical procedures. If careful study of the extra training and practice costs associated with doing surgery cannot justify a 2-3 fold premium, then an across-the-board rollback in surgical payments may be warranted.

1.4 Overview of Report

Chapter 2 describes our data sources, especially the physician survey. The data collection methodology used to obtain time and complexity estimates is described in detail. Also included is a detailed discussion of our data cleaning and editing procedures. Chapter 3 presents data on frequency of procedure performance, time, and complexity and examines the inter-rater reliability of time and complexity. In Chapter 4, we present our methodology for identifying overpriced procedures, and then in Chapter 5 use that methodology to derive predicted payment levels based on time and complexity. Finally, in Chapter 6, we summarize our preliminary findings and discuss their policy implications.

2.0 DATA AND METHODS

2.1 Overview

Analyses in this report were conducted using data from two sources. Time and complexity data were obtained from a 1987 Follow-up Survey to the 1983 Physicians' Practice Costs and Income Survey (PPCIS). Charge data were obtained from 1985 Medicare Part B claims (BMAD) data. This chapter describes each one of these data sets, with special emphasis on the Follow-up Survey. A final section describes the methods used to produce procedure-specific time and complexity estimates.

2.2 Description of the 1987 Physicians' Practice Follow-Up Survey

The 1983 Physicians' Practice Costs and Income Survey provides a rich data base with which to analyze the impact of Medicare policy changes on physicians' practice patterns. However, much of the information from the original survey is outdated, and time and complexity data needed for this study were lacking. Therefore, in 1986, HCFA and ASPE jointly sponsored a follow-up survey to the 1983 PPCIS. The 1987 survey was to address four main research areas:

- Medical Malpractice Costs
- Medicare Physician Participation
- Time and Complexity of High Volume or High Cost Medicare Procedures
- Composition of Global Surgical Fees

Because it is possible that major premium increases have occurred since 1983, and since information on malpractice insurance costs is unavailable to ASPE/HCFA from any other single source, it was necessary to update and expand similar information collected in the 1983 survey to further study the need for malpractice insurance reform.

Another important area of program evaluation concerns physician "participation" in the Medicare program (that is, the decision to accept <u>all</u> Medicare cases on assignment). While carrier records provide aggregate participation rates, they do not permit any detailed analyses of rates because of the lack of "same source" information on credentials, Medicare dependence (relative to total patient load), and other physician characteristics. Only a survey can provide this information at the individual respondent level. The

1987 follow-up survey was designed to provide information with which to answer questions regarding the impact of the participation program on physicians' practices.

Finally, most relevant to the purposes of this report, information on the time, complexity, and billing practices for selected procedures in certain specialties was obtained. A detailed description of this portion of the survey is provided in the sections below.

2.2.1 Sample Design and Response Rates

To obtain information pertinent to these four major research areas, a subset of physicians from the original sample was recontacted, making the sample design of the follow-up survey a function of the original 1983 sample design. For this reason we review the original survey design in addition to the design of the 1987 follow-up.

The original 1983 sampling frame was the list of 331,264 physicians contained in the 1984 Physician Master File and maintained by the American Medical Association. (The sampling frame is a listing from which the sample is to be selected and should include virtually all members of the target population.) In contrast to previous years, physicians in office-based and hospital-based practices are included, as well as physicians in large group practices (more than nine physicians), and in alternative practice modes such as HMOs, PPOs, and IPAs.

The target population of the 1983 PPCIS included physicians meeting the following criteria:

- in active practice at the time of interview, providing patient care at least 20 hours per week in an office-based or hospital-based setting (excluding residents, full-time faculty members, and research fellows);
- engaged in patient care during some part of calendar year 1983;
- not employed by the Federal Government;
- practicing in the 50 United States and the District of Columbia (but excluding the U.S. territories); and
- belonging to a recognized medical specialty, excluding osteopaths, chiropractors, dentists, and limited license physicians.

NORC used a single stage, stratified element level, random sampling design based on 136 discrete strata that were defined in three basic dimensions: Specialty, Geographic Region, and Degree of Urbanization. The

sample allocation among the strata was proportional to the distribution in the population except for low incidence specialties. Four office-based specialties were oversampled to achieve a minimum of 200 sample cases (cardiology, orthopedic surgery, ophthalmology, urology), while three hospital-based specialties were oversampled to obtain a minimum sample size of 300 cases (radiology, anesthesiology, and pathology). Of the 8,954 physicians eligible for the 1983 PPCIS, 4,729 (67.6%) completed the survey, with wide variation in completion rates by specialty.

Only those physicians who completed the 1983 survey were contacted for the 1987 follow-up survey. Of that group, only those reporting themselves to be in one of the specialties shown in Table 2-1 were recontacted. Excluding pediatricians, pathologists, and psychiatrists, and quite a few other small medical specialties, yielded a potential sample of 3,554 for the follow-up survey.

The eligibility requirements were not as stringent for the follow-up survey as for the original one. Basically, only physicians not providing at least 20 hours of patient care a week for six months during 1986 were excluded. This generally eliminated physicians who had retired or who had switched from providing patient care to teaching or research. Of the original 3,554 physicians contacted, 186 were considered "out-of-scope" or ineligible for the follow-up survey (see column 2 of Table 2-1). In addition to ineligible physicians, another 879 refused to complete the follow-up survey, yielding a final sample size of 2,499 and an overall completion rate of 74.2 percent.

As in the original survey, completion rates vary widely among specialties (see Table 2-1). Radiologists and anesthesiologists had the highest rates (83% and 82%, respectively) and cardiologists, the lowest (only 57.4%). In general, completion rates in the follow-up survey were only slightly higher than those of the original survey.

The Final Methodological Report, prepared by NORC, displays adjusted completion rates which take into account non-response in both the 1983 PPCIS and the 1987 Follow-up Survey. Slightly more than half (51.3%) of those who were eligible for both surveys completed the Follow-up Survey. The adjusted completion rates range from 31.1 percent among cardiologists to 64.0 percent among anesthesiologists.

To obtain national estimates from PPCIS data, it is generally necessary to apply weights that account for (1) oversampling of small specialties; (2) the distribution of physicians among regions and between urban and rural locations; and (3) non-response bias. However, we believe that such weighting is not appropriate for our analysis, since our analysis is at the procedure level rather than using the physicain as the unit of analysis. Consequently,

TABLE 2-1

COMPLETION RATES BY SPECIALTY

Specialty	1986 Original Sample	Out-of-Scope*	Net Sample	1986 Completion Rate
TOTAL	**3,554**	**186**	**2,499**	**74.2**
Anesthesiologists	329	17	256	82.1
Cardiologists	159	4	89	57.4
Cardiovascular/Thoracic Surgeons	43	3	25	62.5
Dermatologists	46	2	26	59.1
Ear/Nose/Throat Surgeons	72	4	48	70.6
Family Practitioners	469	35	334	77.0
Gastroenterologists	52	0	37	71.2
General Practitioners	232	16	174	80.6
General Surgeons (includes other surgery)	263	20	179	73.7
Internists (includes other medical)	643	31	449	73.4
Neurological Surgeons	31	0	24	77.4
Neurologists	49	2	36	76.6
Obstetricians/Gynecologists	286	8	205	73.7
Ophthalmologists	162	9	104	68.0
Orthopedic Surgeons	162	4	104	65.8
Plastic Surgeons	45	0	34	86.9
Radiologists	326	26	250	83.3
Urologists	185	5	125	69.4

*Physicians were designated "out-of-scope" if they no longer provided 20 hours of patient care a week during at least six months of 1986.

some of the procedures included in the analysis (particularly those with small sample sizes because so few physicians perform them) may not necessarily be performed in rural areas, in part, because they involve the use of new, expensive equipment. Thus, weighting for the geographic distribution of physicians would be unnecessary and possibly inappropriate.

Moreover, because many of our respondents refused to respond to the questions on complexity, the existing weights would not adjust for this type of non-response. For these reasons, we forego the use of weights in this analysis.

2.2.2 Relevant Questionnaire Items

Each physician was asked to provide information regarding their performance of 10 to 15 procedures that varied by specialty. Specifically, physicians were asked to provide the following information for each procedure:

- how often they performed the procedure in the past year;
- how long it took them on average to perform the procedure for a typical patient in their practice; and
- how they would rank the procedure in terms of complexity on a scale of 1 to 100 relative to the most complex procedure on their list.

Exhibits 2-1 and 2-2 show the exact wording of the questions relevant to this analysis.

Physicians were also asked to provide additional information on average times spent on in-hospital pre- and post-operative care, and post-hospital office visits for certain surgical procedures. Specifically physicians were asked:

- How many minutes do you spend providing in-hospital pre-operative care for this procedure?
- Altogether, how many minutes do you spend providing in-hospital post-operative care for this procedure?
- Altogether, how many minutes do you spend providing post-hospital care for this procedure?

Physicians were also asked questions regarding their usual billing practices for selected surgical procedures which have been analyzed in another report (Rosenbach 1987).

To determine whether anesthesiologists rate complexity for surgical procedures similarly to surgeons (and vice-versa), these physicians were asked

EXHIBIT 2-1

EXACT WORDING OF THE TIME AND FREQUENCY OF PERFORMANCE QUESTIONS USED IN THIS ANALYSIS*

28. Now I'd like to ask you about the time involved in performing several procedures and services for a typical patient. Enclosed with the letter we sent you was a blue card listing several procedures. Do you have that card handy? (IF NO: I'll read you the list of procedures. As I read the procedure, it will be helpful for you to write it down so that you will have it for the next set of questions.)

INTERVIEWER: DID R HAVE BLUE CARD AVAILABLE? YES.....1
NO......2

A. In the past year, how often have you personally performed a/an (PROCEDURE)**:

___ 1. At least once a week;
___ 2. Once a month;
___ 3. Less than once a month but at least once in the past year;
___ 4. Not in the past year; or
___ 5. Never.

B. For a typical patient in your practice, please estimate, on average, how long a/an (PROCEDURE)** actually takes to perform. (PROBE: "ON AVERAGE")

___hours ___minutes

*Instructions for interviewers, but not respondents, are capitalized.

**Interviewers named the first procedure on the list for the respondent's specialty and repeated the question for each procedure on the list.

EXHIBIT 2-2

EXACT WORDING OF THE COMPLEXITY QUESTIONS USED IN THIS ANALYSIS*

30. Some procedures and services take a long time but are relatively straight-forward. Others are very brief but require extraordinary skill and concentration.

I'd like you to rank each of the procedures and services on the list according to its relative complexity, independent of the time it takes to perform the procedure. In ranking the procedures consider only services rendered during the actual procedure. Please take into account:

the _judgment_ required to choose the appropriate approach;

the level of technical _skill_ required;

the degree of _effort_ involved -- both mental _and_ physical effort; and

the amount of emotional _stress_ incurred as a result of diagnostic uncertainty or the amount of risk.

A. Looking at the list, which of the procedures or services _on the list_, regardless of time considerations, is the most complex or _difficult_ to perform (whether or not you personally perform any or all of these procedures)? RECORD PROCEDURE NUMBER FROM Q.31.

PROCEDURE # ____ ENTER "100" NEXT TO PROCEDURE IN Q. 31.

B. Which of the procedures and services _on the list_ is the least complex to perform? RECORD PROCEDURE NUMBER FROM Q.31.

PROCEDURE # ____

C. On a scale of 1 to 100, let's assign a rank of 100 to (READ PROCEDURE FROM Q.30A), which you selected as the most complex or difficult procedure on the list. Now, how would you rank the complexity of (READ PROCEDURE FROM Q.30B), on that same scale? For example, if you think that (READ FROM Q.30B) is half as difficult as (READ FROM Q.30A), then you would assign it a rank of 50; if you think it is one-fifth as difficult you would give it a rank of 20; if you think it is on the extreme other end of the complexity scale you might give it some rank less than 5. In other words, please use the full range of the scale from 1 to 100.

RANK FROM 1 TO 100: ____ ALSO ENTER IN Q.31

31. Now please rank the other procedures and services on the list between (READ RANK FROM 30C) and 100, in relation to the procedures you have just mentioned.

PROCEDURE: ______________
What is the relative complexity of a/an (PROCEDURE)?

*Instructions for interviewers, but not respondents, are capitalized.

to rate the complexity of four additional surgical procedures (as well as to report how much time is spent by the surgeon actually performing the procedure). Surgeons in some specialties were asked to rate the complexity of an additional anesthesia procedure along with the complexity ratings for surgical procedures. (Surgeons were also asked how much time, above and beyond the surgery, the anesthesia takes.) These data, however, are not analyzed in this report.

Information for one procedure (interpretation and report for a chest x-ray) was collected from all 18 specialties. This provided us with a common procedure that could be used to make cross-specialty comparisons. Similarly, procedure lists for all specialties (except anesthesiologists and radiologists) included initial office and hospital visits. Other procedures varied by specialty, although there was some overlap.

Procedure lists for internists, general practitioners, and family practitioners were identical, and lists for dermatologists and plastic surgeons were almost identical. Other specialties had one or two procedures in common with one or two other specialties. For example, two specialties (general surgeons and obstetricians/gynecologists) were asked to estimate the time and complexity of a total abdominal hysterectomy. Such overlap allows for comparison of procedure times and complexity by specialty.

Anesthesiologists, radiologists, and general surgeons were divided into two groups and asked to report time and complexity for one of two slightly different procedure lists. About half of the procedures were common to both lists, while the others were unique. Consequently, pooling the data from the separate lists yields information on more procedures than were obtained from other specialties (between 17 and 22 procedures per specialty rather than 10 to 15).

Physicians not performing a procedure at least once a year were not considered experienced enough with the procedure to provide a good estimate of how long it would take to perform. Consequently, physicians were not asked to report times for infrequently performed procedures.

However, physicians were asked to provide complexity scores for all the procedures on their list whether or not they performed them. Physicians assigned a score of 100 to the procedure on their list that they considered to be the most complex. By requiring physicians to rank all procedures, we ensured that relatively simple procedures would not receive scores of 100 simply because they were the most complex procedures that several physicians performed.

2.2.3 Missing Data and Editing

Sample sizes sometimes vary considerably for mean time and complexity estimates within a specialty due to missing time and complexity data for some

procedures. Time data are usually missing because a physician did not perform a procedure frequently enough to be asked to provide a time estimate. In these cases, sample sizes fall, but time and complexity estimates remain unbiased. However, some physicians found it difficult to provide an "average" time while others claimed there was no "typical" patient. Consequently these physicians insisted on giving a range of time or refused to answer altogether.* This type of missing data could possibly introduce bias to the estimates in addition to lowering sample sizes.

Missing complexity data were generally the result of physicians refusing to rank certain procedures, either because they did not perform them often enough to know how complex they were, or because they felt that the procedures were not comparable. For similar reasons, some physicians refused to cooperate by simply assigning a value of 100 to all procedures, supplying ordinal ranks, or providing very little variation in their complexity scores. Other physicians would cooperate at first and begin rating procedures but would give up after scoring only two or three procedures.

To address these data problems, a number of algorithms were developed to edit the data with a conscious effort to eliminate as few cases as possible. First of all, when physicians provided a range of time for a procedure, the midpoint of the range was entered as the average time. Second, a specialty-specific algorithm was developed to exclude from the complexity analysis physicians who provided little variation in their complexity scores. This algorithm also eliminated physicians who refused to rate any (or few) of the procedures, as well as those who refused to cooperate by rating all the procedures equally complex.

Specialty-specific threshold levels for eliminating these physicians were determined based on the number of procedures included in that specialty list and by inspecting individual cases with little variation. As shown in Table 2-2, specialty sample sizes ranged from a high of 449 internists to a low of 24 neurological surgeons. Procedure lists varied in number among specialties as well. The most procedures any one physician was asked to rate in complexity was 15 (by anesthesiologists, cardiologists, ophthalmologists, and radiologists).** The smallest number was 11 (by dermatologists, plastic

*Because interviewers were instructed to record any comments made by the respondent, we have a considerable amount of anecdotal information on physicians' reasons for refusing to respond.

**The number of procedures shown for anesthesiologists and certain surgical specialties includes procedures excluded from our complexity analysis (see Section 2.2.2). However, these additional procedures were included in developing thresholds for insufficient complexity score variation.

TABLE 2-2

SPECIALTY-SPECIFIC THRESHOLDS FOR EXCLUDING CASES FROM COMPLEXITY ANALYSIS

Specialty	Number of Physicians	Number of Procedures*	Threshold for Insufficient Variation**	Percent of Sample Excluded
Anesthesiologists (Group 1)	130	15	2	10.0%
Anesthesiologists (Group 2)	126	15	3	12.7
Cardiologists	89	12	3	7.9
Cardiovascular/ Thoracic surgeons	25	15	0	12.0
Dermatologists	26	11	1	11.5
Ear/Nose/Throat Surgeons	48	11	2	10.4
Family Practitioners	334	13	3	11.1
Gastroenterologists	37	14	3	5.4
General Practitioners	174	13	3	13.8
General Surgeons (Group 1)	92	14	2	13.0
General Surgeons (Group 2)	87	14	5	13.8
Internists	449	13	3	11.1
Neurological Surgeons	24	13	2	12.5
Neurologists	36	13	3	5.6
Obstetricians/ Gynecologists	205	11	2	8.8
Ophthalmologists	162	15	4	14.4
Orthopedic Surgeons	104	13	3	11.5
Plastic Surgeons	34	13	3	11.5
Radiologists (Group 1)	132	15	2	12.1
Radiologists (Group 2)	119	15	3	11.8
Urologists	125	12	2	8.8

*The number of procedures shown here differs from the number of procedures for which some specialties were asked to provide time estimates. All surgical specialties (except ear/nose/throat surgeons, dermatologists, and plastic surgeons) were asked to rate the complexity of an additional anesthesia procedure along with their surgical procedures. Anesthesiologists were asked to rate four additional surgical procedures along with their anesthesia procedures.

**Values indicate the minimum number of different complexity rankings required for inclusion in the analysis.

surgeons, ear, nose and throat surgeons, and OBGYNs). Clearly we would expect OBGYNs to have fewer unique complexity scores than say, ophthalmologists who were asked to rate a larger number of procedures. Table 2-2 shows that, indeed, the cut-off threshold for OBGYNs is lower than the one for ophthalmologists (2 unique scores vs. 4).

Differences among specialties in the number of unique scores required to meet the edit thresholds were not only related to the number of procedures, but also to the similarity of procedures on the list for a particular specialty.

There was also variation in the numbers of physicians who refused to provide estimates altogether and of those refusing to cooperate. Thus, while the portion of physicians eliminated in two specialty groups might be similar, they may have considerably different thresholds. For example, general surgeons in group 2 with 5 or fewer unique complexity scores were excluded from analysis, compared with general surgeons in group 1 with only 2 unique scores. Although considerably different, these thresholds resulted in eliminating a similar proportion of surgeons in each group, 13.8 percent in group 2 versus 13.0 percent in group 1.

The cut-off at 4 unique complexity scores for ophthalmologists eliminated the largest proportion of physicians (14.4 percent) from any one specialty, while a threshold of 3 unique scores for gastroenterologists eliminated the lowest proportion of physicians, only 5.4 percent of the sample. Similarly, only 12 percent of cardiovascular surgeons who refused to provide complexity scores for any of the procedures were deleted (3 out of 25 in the sample). However, none of the 22 remaining surgeons ever used less than five unique complexity scores to rate the 15 procedures in their list.

Data on pre-operative, post-operative, and post-hospital times required editing similar to the intraoperative time data. However, confusion over the site of pre- and post-operative care may have led to misreporting of these times. Because physicians were asked to report <u>in-hospital</u> pre- and post-operative times, physicians performing the services on an outpatient basis did not always know how to respond. Recorded verbatim comments by the physicians suggest that for some procedures, quite a large proportion of physicians performed pre- and post-operative services on an outpatient basis. Most of these physicians also reported zero in-hospital pre- and postoperative times.

In one case a physician explicitly stated that the reported pre- and post-operative times were based on only a very small proportion of his/her patients for whom he/she performed the procedure on an inpatient basis. These times were set to missing since they presumably were not for the physician's "typical" patient. Given the wide variation of these reported times, and the

positive skewness of the mean times, it is quite possible that other physicians were also failing to report pre- and post-operative times for their "typical" patient when they usually performed these services on an outpatient basis. Of course, many other factors can explain wide variation in pre- and post-operative surgical times, including casemix differences, practice style variation, and perhaps different billing practices across areas.

A number of measures were taken to edit the data with a conscious effort to eliminate as few cases as possible. For example, univariates on reported times and time ratios identified outliers. Further investigation of outliers on a case by case basis identified keypunch errors. When it was not possible to ascertain whether or not the outlier was a keypunch error, it was not replaced. If the outlier was more than twice as large as any other reported time for that procedure, it was set to missing. This practice resulted in eliminating very few observations, although sample sizes for mean pre- and post-operative times are often slightly smaller (i.e., by one or two physicians) than for operative times as a result of these edits.

2.3 National BMAD Data

Beginning with calendar year 1983, HCFA began collecting detailed Part B Medicare data files (known as BMAD) from all of its carriers. (Before 1983, only summary data were available for physicians' bills.) The BMAD file used for this analysis is the 1985 beneficiary file, a five percent random sample of Medicare beneficiaries including all of their claims. Since the sample is drawn based upon the last two digits of social security numbers, the selected beneficiaries remain permanently in the file (until death). All detail is preserved at the claim (line item) level.

From these claims data, Medicare allowed charges were obtained for those procedures for which we have time and complexity data, and means calculated. These allowed charges represent national Medicare reimbursement levels.

2.4 Methods for Generating Mean Time and Complexity Estimates

Although physicians performing procedures at least once a year were asked how long it took them to perform the procedure, only the reported times of physicians performing the procedure at least monthly were used in our analysis. Physicians who performed the procedure less frequently were not considered familiar enough with the procedure to provide accurate estimates of performance time.

For purposes of consistency, we also restricted the calculation of mean complexity estimates to physicians performing procedures at least monthly. A secondary reason for not including complexity scores of physicians performing the procedure infrequently was a tendency for these physicians to refuse to rate the procedures altogether, or to give inconsistent or invalid estimates. Inspection of the complexity data reported by those who performed the procedure frequently (i.e., at least monthly) versus those performing it infrequently revealed a much higher rate of refusals and outliers among the physicians performing the procedure infrequently.

3.0 TIME AND COMPLEXITY ESTIMATES

3.1 Introduction

In this chapter, we present mean operative time and complexity estimates by procedure for each of 18 specialties: nine surgical specialties -- orthopedic, cardiovascular/thoracic, general, plastic surgery, urology, ophthalmology, obstetrics/gynecology, otolaryngology, and neurosurgery; seven medical specialties -- general and family practice, internal medicine, cardiology, dermatology, gastroenterology, and neurology; and radiology and anesthesiology. Pre-operative and postoperative times are also shown for relevant procedures and specialties.

Standard deviations are presented to provide a measure of the variation around those means. This variation must be interpreted cautiously, for it is not necessarily evidence that physicians had difficulty understanding and responding to the questions. Even relatively homogeneous procedures, like surgery, can be expected to vary in operating times and perceived complexity across physicians, as a function of individual style (e.g., "slow" versus "quick" surgeons), experience (how many the surgeon has done before), patient characteristics (even a "typical" patient will vary across physicians), practice organization (e.g., inpatient vs. ambulatory surgery), and availability of support staff (i.e., assistant surgeons, technicians, nurses, etc.) Regional variation in billing practices may also underlie variation in non-operative times.

Because we felt that the accuracy of a physician's response would be affected by the frequency with which (s)he performed a procedure, we had first asked each physician how often (s)he performed the procedure. Only physicians performing the procedure at least once a year were asked to report the time that it took. Because the procedures were to be ranked on a scale of relative complexity, everyone was asked to score all of the procedures. As described in the previous chapter, however, many physicians refused to rank procedures that they did not personally perform. For consistency, therefore, we use in our analyses estimates of time and complexity from physicians who perform the procedure at least once a month. It was also felt that these responses were likely to be clinically more valid. For the interested reader, however, we do show complexity scores for both sets of physicians: those who provide the service monthly, and those who do so less frequently.

3.2 Procedure Time and Complexity Estimates

3.2.1 Orthopedic Surgery

Frequency of Performance

Although included as a screener question, frequency of performance is of interest in its own right. While the sample size underlying each time and complexity estimate is shown in this chapter, these data only provide a general idea of the proportion of physicians performing the procedure at least monthly. For this reason, we present tables showing the exact frequency of procedure performance by specialty in Appendix A. As an example, we present detailed frequency of performance data for orthopedic surgeons only. Table 3-1 shows the percent distribution of survey orthopedic surgeons based on whether they perform the procedure at least once a week, at least once a month (but not weekly), at least once a year (but fewer than 12 times annually), less than once a year, and never. The percentages sum to 100 percent by row (procedure).

Nearly all orthopedic surgeons (94.2%) provide an initial office visit for a new patient at least once a week and approximately three quarters of orthopedic surgeons provide initial hospital visits, and interpretation and report for spine and hip X-rays at least once a week. A majority of physicians reported performing almost all the procedures at least monthly. The three exceptions are secondary hip revision, hemilaminectomy for excision of a herniated disk and interpretation and report of a chest x-ray.*

Nearly a quarter of these surgeons (22%) never perform secondary hip revisions and 29 percent never perform a hemilaminectomy, while another 20 percent perform each of these procedures less than once a year. These results reflect further within-specialty specialization by orthopedic surgeons. Many surgeons may specialize in a small number of procedures, almost never performing others, while others confine their practice to subdivisions of orthopedic surgery not well represented by our selected procedures (e.g., sports medicine).

Procedure Time

Average estimated times (in minutes) are shown for the same set of orthopedic surgery procedures in Table 3-2. Only times reported by physicians performing the procedure at least once a month are included on Table 3-2.

*All physicians regardless of specialty were asked to report performance frequency, time, and complexity for interpretation and report of a chest x-ray. This provided a procedure common to all specialties allowing scores to be standardized for cross-specialty comparisons (see Chapter 4.0).

TABLE 3-1

FREQUENCY OF PROCEDURE PERFORMANCE FOR ORTHOPEDIC SURGEONS

PROCEDURES	N	PERCENT OF ORTHOPEDIC SURGEONS PERFORMING THE PROCEDURE: Weekly	Monthly	At least Once Annually	Less than Annually	Never
Initial comprehensive office visit for a new patient (CPT-4 90020)	104	94.2	2.9	0.0	1.0	1.9
Initial comprehensive hospital visit (with history and examination) for a new or established patient (CPT-4 90220)	104	76.9	10.6	6.7	2.9	2.9
Interpretation and report (only) for a chest X-ray with two views (CPT-4 71020)	104	11.5	2.9	6.7	6.7	72.1
Interpretation and report (only) for a spine X-ray--lumbosacral, antero-posterior, and lateral (CPT-4 72100)	104	77.9	3.8	2.9	3.8	11.5
Interpretation and report (only) for a complete hip X-ray--unilateral, with a minimum of two views (CPT-4 73510)	104	76.9	4.8	1.9	3.8	12.5
Simple hip arthroplasty (total hip replacement) (CPT-4 27130)	104	22.1	40.4	18.3	10.6	8.7
Secondary hip revision (CPT-4 27135)	103	3.9	12.6	41.7	19.4	22.3
Total knee replacement (CPT-4 27447)	104	15.4	35.6	27.9	8.7	12.5
Femoral fracture with internal fixation (CPT-4 27236)	103	10.7	37.9	33.0	9.7	8.7
Intertrochanteric or pertrochanteric femur fracture with internal fixation (CPT-4 27244)	103	25.2	47.6	11.7	7.8	7.8
Hemilaminectomy for excision of a herniated disk and/or de-compression of a nerve root--lumbar unilateral (CPT-4 63030)	102	10.8	24.5	15.7	19.6	29.4
Major joint arthrocentesis (CPT-4 20610)	101	45.5	28.7	12.9	6.9	5.9

Source: Data shown here were obtained from the 1987 Physicians' Practice Follow-up Survey.

TABLE 3-2

PROCEDURE TIME AND COMPLEXITY: ORTHOPEDIC SURGEONS

	PERFORMED AT LEAST MONTHLY						PERFORMED LESS THAN MONTHLY		
PROCEDURES	N	Mean Time	Standard Deviation	N	Mean Complexity	Standard Deviation	N	Mean Complexity	Standard Deviation
Initial comprehensive office visit for a new patient (CPT-4 90020)	100	34.7	17.0	85	29.8	26.0	1	10	--
Initial comprehensive hospital visit (with history and examination) for a new or established patient (CPT-4 90220)	91	37.2	17.5	82	29.9	24.9	9	27.2	14.2
Interpretation and report (only) for a chest X-ray with two views (CPT-4 71020)	15	7.0	4.0	13	13.8	14.2	51	11.3	11.1
Interpretation and report (only) for a spine X-ray--lumbosacral, antero-posterior, and lateral (CPT-4 72100)	84	7.8	4.5	76	17.3	14.0	12	25.0	21.0
Interpretation and report (only) for a complete hip X-ray--unilateral, with a minimum of two views (CPT-4 73510)	84	5.9	4.2	76	15.3	13.2	11	17.9	14.9
Simple hip arthroplasty (total hip replacement) (CPT-4 27130)	65	127.2	42.4	60	65.9	21.0	32	79.0	17.0
Secondary hip revision (CPT-4 27135)	17	182.6	71.6	16	95.8	10.5	73	95.4	11.9
Total knee replacement (CPT-4 27447)	53	121.0	45.0	49	76.3	16.9	43	80.1	15.6
Femoral fracture with internal fixation (CPT-4 27236)*	49	99.3	35.6	44	67.4	14.8	47	60.6	20.0
Intertrochanteric or pertrochanteric femur fracture with internal fixation (CPT-4 27244)*	74	91.6	37.8	68	57.3	20.4	24	59.6	24.8
Hemilaminectomy for excision of a herniated disk and/or de-compression of a nerve root--lumbar unilateral (CPT-4 63030)	36	107.9	62.7	32	77.4	22.6	54	74.5	20.2
Major joint arthrocentesis (CPT-4 20610)	75	16.1	16.7	68	20.9	24.0	22	33.2	30.4

Source: Data shown here were obtained from the 1987 Physicians' Practice Follow-up Survey.

As a result, sample sizes for individual procedures may be considerably smaller than the total number of orthopedic surgeons actually surveyed (n=104). It should also be noted that times for surgical procedures represent "skin-to-skin" times only, excluding time spent in pre- and postoperative care. Times for pre- and postoperative visits for the surgical procedures are shown in Section 3.3.

Of all the selected procedures, secondary hip revision takes the longest time to perform, over three hours on average (182.6 minutes). By contrast, the original hip replacement takes only about two hours. This is not surprising, as revisions or repairs for previous surgery generally are more time-consuming. Longer times for the secondary hip revision may also reflect the fact that it is a newer procedure. As the population ages, this procedure is likely to be performed more frequently, and surgeons will become more expert and possibly quicker at performing it.

Like hip replacements, knee replacements also take about 2 hours to perform, giving the estimates some face validity. Additionally, surgeons reported similar times for both types of hip fractures: 99 minutes for the femoral fractures, and slightly less (92 minutes) for the less complex intertrochanteric or pertrochanteric ones. By contrast, initial office and hospital visits average about 35 minutes.

As a rule, the standard deviations around average surgical times are low, about one-third of the mean. Consider total hip replacements, for example, which take 2 hours and seven minutes for the average surgeon. The standard deviation of 42 minutes implies that the majority of orthopedic surgeons spend anywhere from an hour and twenty-five minutes to almost three hours (127 ± 42) in the operating room. Such variation is to be expected given physician differences in the use of assistant surgeons, previous experience with the operation, and personal style (particularly how quick he or she is). By contrast, standard deviations for visits are relatively larger, about one-half of the mean. Compared with narrowly defined surgical operations, however, visits are far more heterogeneous. Times will vary based both upon physician characteristics (how busy the surgeon is, personal practice style, etc.) and upon patient characteristics, like diagnosis and reason for visit. Although physicians were asked to report times for their "typical" patient, this "typical" patient will vary depending on the surgeon's area of specialization and the community he or she serves. What does this variation in reported times mean for purposes of our study? Whether the standard deviations should be considered large or small is a matter of judgment. To objectively determine how similar these estimates are across physicians, we need to calculate their intraclass correlation (a measure of inter-rater reliability). We do this for both time and complexity in Section 3.5.

Procedure Complexity

Although physicians were explicitly asked to rank the complexity of a procedure independent of the time that it took, Table 3-2 shows that surgeons generally give high complexity scores to the more time-consuming procedures. This result may reflect physicians' inability to separate the impact of time on procedure complexity. Among physicians performing the procedures frequently (i.e., at least once a month), a secondary hip revision is considered the most complex (with an average score of 96 on a scale of 1 to 100), followed by a hemilaminectomy (77), and a total knee replacement (76). By contrast, interpretation and report of x-rays are considered the least complex procedures, with complexity scores ranging from 14 to 17.

Not surprisingly, the standard deviations around mean complexity scores are larger than those for the time estimates, particularly for those rated as relatively less complex, like visits, which are more heterogeneous in content. Since complexity is a much less objective measure than time, we would expect there to be more variation around the complexity means. Perceived complexity is itself a subjective judgment on the part of physicians. In addition, some physicians may have had greater difficulty working with an arbitrary scale of one to 100 (unlike minutes where the scale is measured in units familiar to all).

The association of relatively larger standard deviations with less complex procedures may reflect the method used to score complexity. Physicians were requested to assign a complexity score of 100 to the procedure they considered the most complex, but were allowed to assign any value between 1 and 100 to the procedure they considered the least complex. While the vast majority of physicians scored the x-rays as least complex, the actual scores for these procedures ranged from 1 to 80. Given this method, there will clearly be less variation among scores for procedures more likely to be designated as the most complex compared with those likely to be designated the least complex.

Surgeons performing the procedures infrequently (less than once a month) reported complexity scores similar to those surgeons performing them frequently. While there are some differences in complexity ranks between the two groups, there do not appear to be any systematic patterns.

3.2.2 Urology

As with orthopedic surgeons, the vast majority of urologists (115 out of a 126 total) make initial office and hospital visits at least once a week (see

Table 3-3). Other frequently performed procedures include transurethral resection of the prostate (TURP), cystourethroscopy as an independent diagnostic procedure (52000, 52005), and dilation of the urethra.

Urologists provide intraveneous urography and lithotripsy much less frequently than the other listed procedures. Less than half of urologists (only 48) perform intravenous urography (pyelography) at least monthly, probably reflecting that intravenous diagnostic procedures are the domain of radiologists. Because it is a relatively new technology, we would expect fewer urologists to perform lithotripsy. Indeed, only 44 urologists (or 35 percent) perform lithotripsy at least monthly and 32 percent perform it less than yearly (see Table A-2 in Appendix A). Urologists undoubtedly reported performing suprapubic prostatectomies less frequently because it is a much more invasive procedure and is generally reserved for prostatic cancer treatment rather than for benign prostatic hypertrophy.

Variation among the times for the urology procedures are relatively small (see Table 3-3). Lithotripsy took the longest time to perform (108 minutes) followed by suprapubic prostatectomies and TURPs (70 and 68 minutes, respectively). Cystourethroscopy (without ureteral catheterization or surgical treatment) is among the quickest procedures, taking only 19 minutes to perform on average. Providing additional services at the same time, like ureteral catheterization or tumor resection, about doubled the time.

Urologists performing the procedures at least monthly reported the highest complexity for lithotripsy (89) and TURPs (88) followed by suprapubic prostatectomies (80). Although more invasive and equally time consuming, suprapubic prostectomies are considered to be less complex than TURPs. Complexity rankings for the cystourethroscopies were in the 25 to 50 range, while dilation of the urethra for a female patient had a complexity score of only 14.

3.2.3 Cardiovascular/Thoracic Surgery

Table 3-4 shows that most cardiovascular and thoracic surgeons performed initial office and hospital visits at least once a month (19 and 22 out of 25 in the sample). However, only about half routinely performed carotid thromboendarterectomies, lung lobectomies, and pacemaker insertions. Again, infrequent procedure performance for many of the other services reflects the fact that many of these surgeons subspecialize. For example, some thoracic surgeons never perform open heart surgery, confining their practice to lung surgery cases.

None of the 25 surgeons interviewed reported performing left heart and combined left and right heart catheterizations more than once a year, and only

TABLE 3-3

PROCEDURE TIME AND COMPLEXITY: UROLOGISTS

PROCEDURES	PERFORMED AT LEAST MONTHLY						PERFORMED LESS THAN MONTHLY		
	N	Mean Time	Standard Deviation	N	Mean Complexity	Standard Deviation	N	Mean Complexity	Standard Deviation
Initial comprehensive office visit for a new patient (CPT-4 90020)	115	34.5	15.2	106	34.8	23.4	8	28.8	22.5
Initial comprehensive hospital visit (with history and examination) for a new or established patient (CPT-4 90220)	115	35.4	16.0	106	38.5	25.1	8	23.6	18.0
Interpretation and report (only) for a chest X-ray with two views (CPT-4 71020)	16	6.0	4.2	15	26.4	25.5	73	21.1	18.3
Intravenous urography (pyelography) (CPT-4 74400)	48	37.8	21.9	44	38.3	25.3	62	30.9	19.6
Transurethral resection of the prostate (TURP) (CPT-4 52601)	124	68.4	24.5	113	87.7	16.6	1	80.0	
Suprapubic prostatectomy (CPT-4 55821)	27	70.0	30.6	26	79.6	20.7	87	84.1	15.0
Lithotripsy (percutaneous nephrostolithotomy or pyelostolithotomy, up to 2 cm) (CPT-4 50080)	44	107.8	67.0	39	88.9	15.4	72	92.4	15.7
Cystourethroscopy (separate procedure) (CPT-4 52000)	121	18.9	11.2	111	32.8	20.4	3	23.3	5.8
Cystourethroscopy with ureteral catheterization (CPT-4 52005)	117	32.5	16.6	107	40.0	19.4	7	45.0	26.1
Cystourethroscopy with fulguration (including cryosurgery) and/or resection of small bladder tumor(s) (0.5 to 2 cm) (CPT-4 52234)	108	37.9	15.5	98	51.2	20.5	14	63.2	26.5
Dilation of urethra for a female patient (CPT-4 53660)	100	11.7	8.6	88	13.7	12.6	24	18.5	23.2

Source: Data shown here were obtained from the 1987 Physicians' Practice Follow-up Survey.

TABLE 3-4

PROCEDURE TIME AND COMPLEXITY: CARDIOVASCULAR/THORACIC SURGEONS

	PERFORMED AT LEAST MONTHLY						PERFORMED LESS THAN MONTHLY		
PROCEDURES	N	Mean Time	Standard Deviation	N	Mean Complexity	Standard Deviation	N	Mean Complexity	Standard Deviation
Initial comprehensive office visit for a new patient (CPT-4 90020)	19	49.7	22.5	17	26.1	20.5	5	10.2	9.1
Initial comprehensive hospital visit (with history and examination) for a new or established patient (CPT-4 90220)	22	43.6	23.7	20	26.7	19.6	2	3	2.8
Interpretation and report (only) for a chest X-ray with two views (CPT-4 71020)	11	8.3	5.0	10	17.1	12.9	10	13.5	16
Permanent pacemaker insertion--single chamber, ventricular (CPT-4 33207)	12	66.3	16.3	11	27.5	14.0	11	45	16.9
Permanent pacemaker insertion--dual chamber, AV sequential (CPT-4 33208)	6	77.5	40.7	5	57.0	20.2	17	42.5	19.3
Carotid thromboendarterectomy (CPT-4 35301)	13	94.2	33.1	10	71.5	21.9	12	57.5	17.8
3 artery CABG (coronary artery bypass graft) (CPT-4 33512)	8	221.3	53.0	7	87.1	13.5	15	86.8	13.5
4 artery CABG (coronary artery bypass graft) (CPT-4 33513)	6	225.0	25.1	5	91.0	15.2	16	93.1	8.1
Aortic valve replacement (CPT-4 33405)	7	201.4	56.7	6	90.0	8.4	15	93.9	9.6
Lung lobectomy (CPT-4 32480)	13	145.4	29.6	12	77.6	16.5	10	75.4	20.2
Swan-Ganz catheterization (CPT-4 93503)	6	21.7	6.8	6	23.3	14.7	16	34.8	34.1
Left heart catheterization, with selective coronary angiography and left ventricular angiography (CPT-4 93547)	0			0			21	46.0	30.2
Combined right and left heart catheterization with selective coronary angiography and left ventricular angiography (CPT-4 93549)	0			0			21	49.2	29.6
Insertion of an intra-aortic balloon catheter (CPT-4 93535)	4	12.0	6.0	4	20.0	14.7	18	48.9	30.7

Source: Data shown here were obtained from the 1987 Physicians' Practice Follow up Survey.

6 insert Swan-Ganz catheters more than once a month. Clearly, these diagnostic procedures are the province of cardiologists.

CABGs and aortic valve replacements are among the most time-consuming procedures, taking in excess of three hours to perform (see Table 3-4). Lung lobectomies take about two hours to perform, carotid endarterectomies almost an hour and a half, and permanent pacemakers slightly over one hour. Swan-Ganz catheterization and intra-aortic balloon insertions take relatively short amounts of time (22 and 12 minutes, respectively).

Standard deviations around mean times are relatively smaller for cardiovascular/thoracic surgeons than for the two earlier groups, reflecting the smaller sample size (25) for this specialty.

Estimates of procedure complexity appear to be positively related to performance times. CABGs and aortic valve replacements are rated the most complex of the 14 procedures in Table 3-4 (between 87 and 91), followed by a lung lobectomy (78), and a carotid thromboendarterectomy (72). Dual-chamber pacemaker insertions, while they take only a few minutes longer than their single chamber counterparts, nevertheless are considered to be twice as complex on average. This reflects the relatively greater skill required to achieve proper placement of the atrial electrodes.

3.2.4 General Surgery

Table 3-5 presents average time and complexity reported by general surgeons. Our sample of general surgeons was randomly divided into two groups to maximize the number of different procedures that could be covered in the survey. The first nine procedures were included in procedure lists for both groups of general surgeons, while the following eight were asked of only one of the two groups. Hence, the lower sample sizes for the latter procedures do not necessarily reflect a lower proportion of physicians performing those procedures.

The largest number and proportion of surgeons (over 150 and more than 90% of those surveyed) routinely perform inguinal hernia repairs, and initial office and hospital visits, (i.e. they perform them at least once a month). (See Table A-4 in Appendix A for the exact frequencies of performance.) Partial colectomies, benign lesion excisions (1 to 2 cm.), cholecystectomies (without common duct exploration), and modified radical mastectomies are also frequently performed by general surgeons.

Many of these frequently performed procedures are the most time-consuming as well. Partial colectomies take over two hours on average, and modified radical mastectomies take over an hour and a half. Although carotid thromboendarterectomies are not as time consuming, surgeons consider

TABLE 3-5

PROCEDURE TIME AND COMPLEXITY: GENERAL SURGEONS

PROCEDURES	PERFORMED AT LEAST MONTHLY						PERFORMED LESS THAN MONTHLY		
	N	Mean Time	Standard Deviation	N	Mean Complexity	Standard Deviation	N	Mean Complexity	Standard Deviation
Initial comprehensive office visit for a new patient (CPT-4 90020)[a]	160	37.2	15.2	137	26.4	23.3	8	21.9	24.7
Initial comprehensive hospital visit, with history and examination for a new or established patient (CPT-4 90220)[a]	162	41.5	18.8	138	29.8	23.5	7	15.0	10.6
Interpretation and report (only) for a chest X-ray with two views (CPT-4 71020)[a]	64	6.9	4.9	57	13.7	13.1	71	14.3	13.3
Permanent pacemaker insertion--dual chamber, AV sequential (CPT-4 33208)[a]	8	78.6	23.3	6	51.7	27.9	117	56.3	24.4
Inguinal hernia repair (CPT-4 49505)[a]	157	56.2	23.7	139	38.3	17.6	14	41.4	23.9
Carotid thromboendarterectomy (CPT-4 35301)[a]	21	92.9	24.9	19	98.4	5.0	116	90.1	14.6
Partial colectomy (CPT-4 44140)[a]	129	129.6	38.8	115	80.6	18.5	38	72.6	19.9
Modified radical mastectomy (CPT-4 19240)[a]	116	108.7	35.4	105	72.4	18.1	48	64.7	17.1
Cholecystectomy with exploration of common duct (CPT-4 47610)[a]	83	112.1	35.4	76	78.0	20.6	77	82.4	18.1
Cholecystectomy without common duct exploration (CPT-4 47600)[b]	72	75.3	27.7	62	67.3	18.9	11	66.4	18.7
Excision of benign lesion on trunk, arms, or legs--1.0 to 2.0 cm (CPT-4 11402)[b]	72	28.3	16.2	62	9.5	8.5	11	11.8	10.3
Excision of benign lesion on trunk, arms, or legs--3.0 to 2.0 cm (CPT-4 11404)[b]	54	37.2	18.7	50	17.6	15.4	25	15.5	10.0
Diagnostic, complex upper GI endoscopy (including esophagus, stomach, and either the duodenm and/or the jejunum) (CPT-4 43235)[b]	18	30.3	15.3	15	37.0	20.2	42	38.1	22.6
Total abdominal hysterectomy (CPT-4 58150)[c]	17	90.9	29.3	16	55.9	17.9	57	60.6	18.7
Diagnostic, fiberoptic colonoscopy, 25 cm to splenic flexure (CPT-4 45360)[c]	28	31.0	21.8	26	28.1	17.5	44	25.6	14.2
Diagnostic, flexible fiberoptic sigmoidoscopy (CPT-4 45330)[c]	34	27.1	19.3	32	22.0	16.3	39	20.7	15.5
Diagnostic, fiberoptic colonoscopy, beyond the splenic flexure (CPT-4 45378)[c]	23	54.2	22.4	22	46.9	21.6	47	34.3	16.1

[a]Procedures were included in lists for both general surgeon groups.
[b]Procedures were included in list for general surgeons in group 2 only.
[c]Procedures were included in list for general surgeons in group 1 only.

Source: Data shown here were obtained from the 1987 Physicians' Practice Follow up Survey.

them far more complex (rated 98 on average compared to only 81 for partial colectomies and 78 for cholecystectomies with common duct exploration). Interestingly, physicians performing these latter procedures only infrequently consider the cholecystectomies with common duct exploration more complex than the colectomies (rating them 82 and 73 respectively). Not surprisingly, cholecystectomies with common duct exploration take longer to perform than those without (112 minutes vs. 75).

As expected, going beyond the splenic flexure almost doubles the time necessary to perform a diagnostic fiberoptic colonoscopy (54 minutes vs. 31), and is rated as substantially more complex. Although it takes the same amount of time as the less extensive colonoscopy, the upper GI endoscopy is considered to be more complicated.

3.2.5 Ophthalmology

Aside from initial office visits, none of the procedures shown on Table 3-6 are performed frequently by an overwhelming majority of ophthalmologists. The low proportion of ophthalmologists performing any one procedure probably reflects the large degree of sub-specialization and differences between medical and surgical ophthalmologists. Interestingly, after initial office visits, the most routinely performed procedure in Table 3-6 is the relatively new, one-step extracapsular lens extraction with IOL implant.

Very few ophthalmologists (only 17) reported performing either intracapsular or extracapsular lens extraction without IOL insertion. Almost double that number (32) routinely perform the subsequent IOL insertions. The lens extractions take slightly longer to perform than the IOL insertion (55 and 48 minutes vs. 40) and altogether, the two-stage procedure takes about an hour and a half. This is compared to only about an hour of surgery time (57 minutes) for the newer, one-stage procedure (CPT-4 code 66984). However, the combined procedure is considered to be considerably more complex than either the extraction or insertion by itself (rated 91 in complexity compared to 77 for the latter two).

By far, the most time-consuming procedure shown is scleral buckling, taking over 2 hours to perform on average. Vitrectomies take considerably longer to perform than most of the other procedures as well. Both were rated among the most complex of all procedures, along with fistulization of sclera, and the one-stage lens procedure.

3.2.6 Obstetrics/Gynecology (OB/GYNs)

Aside from office and hospital visits, most OB/GYNs frequently perform total abdominal hysterectomies, and cervical and endometrial biopsies (note the sample sizes in Table 3-7). On average OB/GYNs take the same amount of

TABLE 3-6

PROCEDURE TIME AND COMPLEXITY: OPHTHALMOLOGISTS

	PERFORMED AT LEAST MONTHLY						PERFORMED LESS THAN MONTHLY		
PROCEDURES	N	Mean Time	Standard Deviation	N	Mean Complexity	Standard Deviation	N	Mean Complexity	Standard Deviation
Initial comprehensive office visit for a new patient (CPT-4 92004)	101	31.8	18.1	85	29.8	21.9	1	40.0	--
Initial comprehensive hospital visit, with history and examination for a new or established patient (CPT-4 90220)	51	43.4	25.5	44	31.2	18.9	40	34.7	21.8
Interpretation and report (only) for a chest X-ray with two views (CPT-4 71020)	3	8.7	7.1	3	13.3	5.8	66	20.4	19.6
Intracapsular lens extraction (CPT-4 66920)	17	54.7	24.0	16	70.9	24.7	71	72.0	16.4
Extracapsular lens extraction without IOL implant (CPT-4 66940)	17	47.6	14.9	16	76.8	17.1	72	78.0	14.1
Extracapsular lens extraction with IOL implant (CPT-4 66984)	69	56.4	27.2	63	91.3	11.8	24	83.7	17.7
Insertion of an IOL subsequent to extraction (CPT-4 66985)	32	40.4	22.2	32	77.3	16.7	55	74.7	16.9
Fistulization of sclera (CPT-4 66170)	11	59.5	45.0	11	84.5	13.1	73	74.7	19.6
Vitrectomy, mechanical (CPT-4 67036)	16	80.6	66.6	16	90.5	11.5	70	88.5	13.7
Scleral buckling (CPT-4 67107)	6	130.0	49.0	5	84.0	8.9	78	90.0	13.8
Laser photocoagulation (CPT-4 67226)	42	37.8	22.5	37	61.4	19.4	48	60.8	18.9
Ophthalmic biometry by ultrasound echography, A-mode (CTP-4 76516)	59	20.8	18.4	58	29.9	18.9	26	28.0	18.8
Ophthalmic biometry by ultrasound echography; by B-scan and/or real time (CPT-4 76517)	22	20.0	8.5	20	34.3	18.4	62	37.1	18.5
Serial tonometry with medical diagnostic evaluation (CPT-4 92100)	32	26.9	20.9	30	29.7	16.8	53	25.6	19.1

Source: Data shown here were obtained from the 1987 Physicians' Practice Follow-up Survey.

TABLE 3-7

PROCEDURE TIME AND COMPLEXITY: OBSTETRICIAN/GYNECOLOGISTS

	PERFORMED AT LEAST MONTHLY						PERFORMED LESS THAN MONTHLY		
PROCEDURES	N	Mean Time	Standard Deviation	N	Mean Complexity	Standard Deviation	N	Mean Complexity	Standard Deviation
Initial comprehensive office visit for a new patient (CPT-4 90020)	199	33.9	12.2	180	36.3	25.3	4	26.3	12.5
Initial comprehensive hospital visit (with history and examination for a new or established patient (CPT-4 90220)	165	38.9	16.0	150	38.0	25.4	32	43.3	26.4
Interpretation and report (only) for a chest X-ray with two views (CPT-4 71020)	20	7.9	6.7	19	23.6	19.6	117	25.4	21.8
Interpretation and report (only) for an abdominal ultrasound (CPT-4 76700)	79	17.1	9.5	74	34.8	22.5	74	35.7	23.4
Total abdominal hysterectomy (CPT-4 58150)	174	91.1	28.4	158	83.2	13.8	27	84.8	15.6
Vaginal hysterectomy (CPT-4 58260)	113	69.1	27.9	103	85.0	12.4	82	85.4	14.5
Vaginal hysterectomy with plastic repair (CPT-4 58265)	97	104.7	28.3	88	98.5	4.3	97	97.8	6.3
Diagnostic D & C (CPT-4 58120)	182	19.7	16.0	168	33.4	20.3	16	23.1	15.8
Endometrial biopsy (CPT-4 58100)	144	13.0	9.0	133	24.4	17.2	53	29.0	25.3
Biopsy of cervix (CPT-4 57520)	155	17.6	12.2	145	24.0	20.2	40	26.2	25.5

Source: Data shown here were obtained from the 1987 Physicians' Practice Follow-up Survey.

time to perform a total abdominal hysterectomy as general surgeons (about an hour and a half). Compared to the total abdominal, they take less time to perform a vaginal hysterectomy (only 69 minutes), although the procedures are considered to be equal in difficulty (with complexity ratings of 85 for the vaginal and 83 for the abdominal). Not surprisingly, vaginal hysterectomies with plastic repair take the longest to perform and are considered the most complex of all listed procedures. In contrast to the hysterectomies, the biopsies take very little time (less than twenty minutes) and are considered very simple.

3.2.7 Neurosurgery

Most neurosurgeons frequently perform craniectomies and hemilaminectomies. Craniectomies for excisions of brain tumors take the longest to perform (over three and one half hours on average) and were also considered the most complex (see Table 3-8). Except for CABGs, no other surgeries even approach the average length of these craniectomies.

Compared with cardiovascular/thoracic and general surgeons, neurological surgeons take 20 minutes longer on average to perform the carotid thromboendarterectomy. However, they report virtually the same average time as orthopedic surgeons for the hemilaminectomy (one and a half hours).

3.2.8 Plastic Surgery

Most plastic surgeons perform all of the procedures shown on Table 3-9 at least once a month. The split graft and adjacent tissue transfer or rearrangement take the longest to perform (approximately 80 minutes each) and are the most complex of the selected procedures. However, tissue transfers or rearrangements are considered more complex than split grafts (rated as 99 on average, compared to 72 respectively).

Excisions of benign lesions on the trunk, arms and legs take slightly longer on average for plastic surgeons than for general surgeons, although plastic surgeons take about the same amount of time as dermatologists for these excisions. However, excisions on the face take longer for plastic surgeons than for general surgeons or dermatologists, suggesting some casemix differences between the specialty groups. Plastic surgeons also consider excisions of facial lesions to be more complicated than other excisions, regardless of the size of the lesion.

3.2.9 Otolaryngology

In addition to visits, most ears, nose, and throat (ENT) specialists frequently perform tonsillectomies on children, control nasal hemorrhages, and

TABLE 3-8

PROCEDURE TIME AND COMPLEXITY: NEUROSURGEONS

PROCEDURES	PERFORMED AT LEAST MONTHLY						PERFORMED LESS THAN MONTHLY		
	N	Mean Time	Standard Deviation	N	Mean Complexity	Standard Deviation	N	Mean Complexity	Standard Deviation
Initial comprehensive office visit for a new patient (CPT-4 90020)	23	52.4	20.1	19	34.1	25.4	1	20.0	--
Initial comprehensive hospital visit (with history and examination for a new or established patient (CPT-4 90220)	24	44.2	16.7	19	35.3	29.1	--	--	--
Interpretation and report (only) for a chest X-ray with two views (CPT-4 71020)	5	7.2	8.0	5	11.2	4.1	9	12.7	10.1
Interpretation and report (only) for a spine X-ray--lumbosacral, anteroposterior and lateral (CPT-4 72100)	15	6.8	4.3	12	11.9	4.4	6	25.5	20.0
Interpretation and report (only) of a complete skull X-ray with a minimum of four views (CPT-4 70260)	11	6.7	3.7	9	14.0	5.9	9	19.7	15.0
Interpretation and report (only) for an EEG--awake, drowsy and asleep (CPT-4 95819)	2	15.0	7.1	2	35.0	21.2	12	17.8	13.3
Carotid thromboendarterectomy (CPT-4 35301)	8	112.5	38.5	8	82.5	15.6	12	77.1	12.7
Hemilaminectomy for excision of a herniated disk and/or decompression of a nerve root--lumbar unilateral (CPT-4 63030)	23	89.1	26.0	19	62.6	21.9	1	90.0	--
Lumbar laminectomy for decompression of the spinal cord (CPT-4 63005)	18	136.9	53.1	14	65.0	25.3	5	75.6	17.5
Craniectomy or craniotomy for evacuation of a hematoma (CPT-4 61310)	22	124.8	60.9	18	74.7	11.8	1	95.0	--
Craniectomy for excision of a brain tumor--supratentorial (CPT-4 615100)	20	216.0	54.7	17	95.9	10.6	3	100.0	0.0
Diagnostic lumbar punture (CPT-4 62270)	15	19.3	9.6	11	22.3	18.6	9	16.2	17.0

Source: Data shown here were obtained from the 1987 Physicians' Practice Follow-up Survey.

TABLE 3-9

PROCEDURE TIME AND COMPLEXITY: PLASTIC SURGEONS

	PERFORMED AT LEAST MONTHLY						PERFORMED LESS THAN MONTHLY		
PROCEDURES	N	Mean Time	Standard Deviation	N	Mean Complexity	Standard Deviation	N	Mean Complexity	Standard Deviation
Initial comprehensive office visit for a new patient (CPT-4 90020)	31	34	13.7	29	37.4	23.8	2	50.0	42.4
Initial comprehensive hospital visit, with history and examination for a new or established patient (CPT-4 90220)	26	35	13.4	23	29.7	17.1	7	73.6	26.1
Intermediate follow-up office visit for an established patient (CPT-90060)	31	15.2	6.3	27	24.1	15.4	2	20.0	14.1
Initial comprehensive consultation (CPT-4 90620)	29	33.8	13.6	25	39.3	21.9	4	33.8	13.8
Interpretation and report (only) for a chest X-ray with two views (CPT-4 71020)	2	7.5	3.5	2	41.0	41.0	21	24.8	19.3
Biopsy of skin, or subcutaneous tissue and/or mucous membrane (CPT-4 11100)	33	25.2	15.7	31	27.6	21.4	--	--	--
Excision of benign lesion on trunk, arms, or legs--1.0 to 2.0 cm (CPT-4 11402)	30	30.8	14.7	28	33.8	22.1	3	53.3	40.4
Excision of benign lesion on trunk, arms, or legs--3.0 to 4.0 cm (CPT-4 11404)	21	46.2	21.1	20	45.5	22.9	11	50.9	24.2
Excision of benign lesion on face, ears, eyelids, nose, or lips--0.5 to 1.0 cm (CPT-4 11441)	31	36.5	23.3	30	55.5	24.9	1	20.0	--
Excision of benign lesion of face, ears, eyelids, nose, or lips--1.0 to 2.0 cm (CPT-4 11442)	31	45.2	24.8	30	64.1	26.7	1	25.0	--
Destruction of facial lesion by any method including local anesthesia (CPT-4 17000)	27	22.9	18.6	26	32.2	30.6	5	43.0	42.2
Split graft of trunk, scalp, arms, legs, hands, or feet--up to 100 sq. cm (CPT-4 15100)	25	83.4	37.4	23	72.4	22.5	8	81.9	16.0
Adjacent tissue transfer or rearrangement of eyelids, nose, ears, or lips--up to 10 sq. cm (CPT-4 14060)	29	79.9	25.6	26	98.7	5.9	5	96.0	8.9

Source: Data shown here were obtained from the 1987 Physicians' Practice Follow-up Survey.

perform direct, operative and diagnostic fiberscopic laryngoscopies. Most procedures shown on Table 3-10 take less than 40 minutes to perform. Only tympanoplasty is particularly time-consuming, taking an hour and a half on average, and it is also considered the most complex.

3.2.10 General Practice, Family Practice, and Internal Medicine

Procedure lists for general practitioners (GPs), family practitioners (FPs) and internists were identical. Hence, we can compare these procedure responses across specialties. Table 3-11 shows that the large majority of physicians in all three specialties reported conducting initial and follow-up hospital visits frequently (i.e., weekly or monthly), but almost no one stated that they perform fiberoptic colonoscopies or upper GI endoscopies with any frequency. Internists do perform the more complex diagnostic procedures and the consultations more often than do FPs and GPs, however.

Times are remarkably similar across the three specialties (see Table 3-11). Internists, however, do spend more time during their initial office and hospital visits and during consultations than do FPs and GPs. For example, internists spend 54 minutes on an initial office visit compared to about 40 minutes in the case of GPs and FPs; times for consultations are 59 and 40-45 minutes, respectively. These differences may reflect the greater complexity of clinical problems dealt with by internists.

There is a relatively narrow range of complexity scores across these three groups of primary care providers, ranging from a low of 32 for interpretation and report of a chest X-ray by all three specialties to a mean score of 86 by internists for a consultation (see Table 3-12). Among the three specialties, complexity scores are very similar for most procedures. An exception is flexible fiberoptic sigmoidoscopy which is ranked more complex by internists (70) than by FPs (63) or GPs (58). This trend of decreasing complexity scores with decreased specialization can be found for a number of other services: initial and follow-up office visits and consultations. All specialties rated colonoscopy, upper GI endoscopy for biopsy, and initial hospital visit as high in complexity, while interpreting chest X-rays, ECGs and conducting follow-up office visits were scored lower.

3.2.11 Cardiology

After visits and ECGs, the most frequently performed procedures shown on Table 3-13 are catheterizations and echocardiographies. Not surprisingly, combined right and left heart catheterization takes longer and is considered

TABLE 3-10

PROCEDURE TIME AND COMPLEXITY: EAR, NOSE, AND THROAT SPECIALISTS

	PERFORMED AT LEAST MONTHLY						PERFORMED LESS THAN MONTHLY		
PROCEDURES	N	Mean Time	Standard Deviation	N	Mean Complexity	Standard Deviation	N	Mean Complexity	Standard Deviation
Initial comprehensive office visit for a new patient (CPT-4 90020)	44	22.8	10.3	40	38.6	27.7	2	37.5	3.5
Initial comprehensive hospital visit, with history and examination for a new or established patient (CPT-4 90220)	43	34.2	15.8	38	41.5	26.2	4	43.8	7.5
Interpretation and report (only) for a chest X-ray with two views (CPT-4 71020)	9	12.2	8.7	9	46.7	25.2	21	30.3	24.6
Interpretation and report (only) for a complete sinus X-ray with a minimum of three views (CPT-4 70220)	33	6.9	5.8	30	29.0	18.4	8	27.0	20.3
Tympanoplasty (without mastoidectomy) (CPT-4 69631)	22	91.4	38.4	20	89.2	27.0	22	89.3	20.6
Tonsillectomy for patient under age 12 (CPT-4 42825)	42	38.0	15.8	39	60.4	23.1	4	48.8	32.8
Planned tracheostomy (CPT-4 31600)	17	35.0	19.7	16	68.4	18.5	27	70.2	24.1
Diagnostic, flexible fiberoptic laryngoscopy (CPT-4 31575)	33	21.4	16.7	30	41.0	23.1	12	59.0	30.7
Operative laryngoscopy direct with biopsy (CPT-4 31535)	38	35.1	20.6	34	58.1	21.5	8	50.5	17.8
Control nasal hemorrhage--anterior, complex, and unilateral (CPT-4 30903)	40	34.7	15.9	35	47.4	23.7	7	55.0	33.0
Basic comprehensive audiometry (CPT-4 92557)	26	29.0	13.1	21	27.3	21.3	18	32.8	24.0

Source: Data shown here were obtained from the 1987 Physicians' Practice Follow up Survey.

TABLE 3-11

PROCEDURE TIMES: GENERAL PRACTITIONERS, FAMILY PRACTITIONERS, AND INTERNISTS[a]

	GENERAL PRACTITIONERS			FAMILY PRACTITIONERS			INTERNISTS		
PROCEDURES	N	Mean	S.D.	N	Mean	S.D.	N	Mean	S.D.
Initial comprehensive office visit for a new patient (CPT-4 90020)	160	39.5	21.8	313	40.6	16.2	432	54.3	21.6
Initial comprehensive hospital visit (with history and examination) for a new or established patient (CPT-4 90220)	119	44.8	21.0	290	50.1	20.9	415	57.6	21.6
Intermediate follow-up office visit for an established patient (CPT-4 90060)	156	17.7	9.2	313	18.7	7.9	421	22.7	10.1
Intermediate follow-up hospital visit (CPT-4 90260)	116	17.8	9.4	295	18.7	9.3	392	20.7	9.2
Initial comprehensive consultation (CPT-4 90620)	86	40.3	21.5	188	44.7	16.8	388	59.3	21.3
Discharge hospital visit (on final day of a multiple-day stay) (CPT-4 90292)	123	24.7	14.1	292	26.4	13.4	397	27.4	12.7
Interpretation and report (only) for a chest X-ray with two views (CPT-4 71020)	81	8.4	6.5	171	7.2	5.6	175	7.4	5.0
Interpretation and report (only) for an ECG (electrocardiogram) (CPT-4 93010)	103	8.4	5.1	228	7.9	5.6	342	7.2	5.8
Diagnostic proctosigmoidoscopy (CPT-4 45300)	54	21.7	12.1	138	21.3	9.2	161	20.5	10.2
Diagnostic, flexible fiberoptic sigmoidoscopy (CPT-4 45330)	25	28.8	9.8	97	29.5	11.5	81	27.7	12.3
Diagnostic, fiberoptic colonoscopy 25 cm to splenic flexure (CPT-4 45360)	10	33.0	13.2	41	30.4	13.9	45	33.7	15.2
Dignostic, complex upper GI endoscopy (including esophagus, stomach, and either the duodenun and/or the jejunum) (CPT-4 43235)	2	30.0	0.0	4	22.5	9.6	21	29.8	16.5
Upper GI endoscopy for biopsy (CPT-4 43239)	1	20	--	4	27.5	8.7	20	30.8	16.9

[a] Includes physicians who performed the procedure at least monthly.

Source: Data shown here were obtained from the 1987 Physicians' Practice Follow-up Survey.

TABLE 3-12

PROCEDURE COMPLEXITY: FOR GENERAL PRACTITIONERS, FAMILY PRACTITIONERS, AND INTERNISTS[a]

PROCEDURES	GENERAL PRACTITIONERS			FAMILY PRACTITIONERS			INTERNISTS		
	N	Mean	S.D.	N	Mean	S.D.	N	Mean	S.D.
Initial comprehensive office visit for a new patient (CPT-4 90020)	139	65.6	29.5	279	67.8	26.2	382	77.1	22.5
Initial comprehensive hospital visit (with history and examination) for a new or established patient (CPT-4 90220)	106	69.6	26.6	259	74.3	26.1	366	82.0	20.6
Intermediate follow-up office visit for an established patient (CPT-4 90060)	137	36.0	20.5	277	35.6	20.6	372	41.7	20.2
Intermediate follow-up hospital visit (CPT-4 90260)	103	41.7	18.6	265	40.5	20.0	349	47.2	20.5
Initial comprehensive consultation (CPT-4 90620)	76	67.2	24.9	173	67.7	24.7	346	86.0	18.6
Discharge hospital visit (on final day of a multiple-day stay) (CPT-4 90292)	107	45.1	23.7	263	46.1	22.1	354	47.9	21.5
Interpretation and report (only) for a chest X-ray with two views (CPT-4 71020)	71	31.9	20.5	154	31.6	19.4	152	31.9	20.7
Interpretation and report (only) for an ECG (electrocardiogram) (CPT-4 93010)	95	36.6	22.3	206	36.2	22.4	306	32.7	22.2
Diagnostic proctosigmoidoscopy (CPT-4 45300)	50	46.2	20.8	127	47.0	21.6	141	41.5	19.5
Diagnostic, flexible fiberoptic sigmoidoscopy (CPT-4 45330)	25	69.8	24.0	89	63.2	19.5	77	58.1	22.0
Diagnostic, fiberoptic colonoscopy 25 cm to splenic flexure (CPT-4 45360)	10	75.0	22.9	37	76.4	16.9	41	80.3	20.5
Dignostic, complex upper GI endoscopy (including esophagus, stomach, and either the duodenun and/or the jejunum) (CPT-4 43235)	1	70.0	--	4	76.3	26.3	18	67.1	19.0
Upper GI endoscopy for biopsy (CPT-4 43239)	1	70.0	--	4	76.3	28.1	17	73.8	14.6

[a] Includes physicians who performed the procedure at least monthly.

Source: Data shown here were obtained from the 1987 Physicians' Practice Follow-up Survey.

TABLE 3-13

PROCEDURE TIME AND COMPLEXITY: CARDIOLOGISTS

	PERFORMED AT LEAST MONTHLY						PERFORMED LESS THAN MONTHLY		
PROCEDURES	N	Mean Time	Standard Deviation	N	Mean Complexity	Standard Deviation	N	Mean Complexity	Standard Deviation
Initial comprehensive office visit for a new patient (CPT-4 90020)	83	55.4	19.8	76	51.5	28.9	5	50.0	26.0
Initial comprehensive hospital visit, with history and examination for a new or established patient (CPT-4 90220)	86	54.1	18.9	79	54.7	29.0	2	42.5	10.6
Interpretation and report (only) for a chest X-ray with two views (CPT-4 71020)	31	6.7	3.8	28	23.5	20.3	52	22.6	18.8
Interpretation and report (only) for an ECG (electrocardiogram) (CPT-4 93010)	78	5.1	5.9	72	20.3	19.0	10	21.4	21.6
Permanent pacemaker insertion--single chamber, ventricular (CPT-4 33207)	26	69.4	27.7	25	63.0	19.8	52	61.6	22.6
Permanent pacemaker insertion--dual chamber, AV sequential (CPT-4 33208)	18	99.4	36.6	18	83.9	18.6	59	75.8	21.5
Swan-Ganz catheterization (CPT-4 93503)	66	42.4	21.9	63	56.6	19.3	19	61.1	23.1
Left heart catheterization, with selective coronary angiography and left ventricular angiography (CPT-4 93547)	49	52.9	24.3	48	82.3	14.3	32	87.7	15.9
Combined right and left heart catheterization with selective coronary angiography and left ventricular angiography (CPT-4 93549)	45	74.2	30.6	44	93.5	13.1	36	92.9	13.6
M-mode echocardiography (CPT-4 93300)	44	23.1	15.4	43	41.9	24.3	37	34.6	22.6
Real time echocardiography (CPT-4 93307)	46	26.6	18.3	45	49.9	26.6	35	43.6	23.9
Doppler echocardiography (CPT-4 93320)	33	28.3	24.2	32	50.6	30.0	48	51.9	24.8

Source: Data shown here were obtained from the 1987 Physicians' Practice Follow-up Survey.

more complex than left only, and Swan-Ganz. In fact, combined right and left heart catheterization is considered to be more complicated than dual chamber pacemaker insertion, although it is reported to take less time (74 minutes compared to 99, respectively). The 99 minutes for the dual chamber pacemaker procedure is a full 30 minutes longer than the estimate for its single chamber counterpart and more than 20 minutes longer than estimates for dual chamber insertions reported by general and cardiovascular/thoracic surgeons. These differences suggest that the average estimate of 99 minutes by cardiologists may be somewhat overstated. Alternatively, cardiologists may perform the procedure less frequently and therefore, less quickly, compared to surgeons who perform the procedure routinely. (There is no reason to expect casemix differences to be a factor here.)

M-mode echocardiography is rated less in time (23 minutes) and complexity (42) than real time or doppler echocardiography. However, the latter two procedures are virtually equal in time (27 and 28 minutes, respectively) and complexity (50).

3.2.12 Gastroenterology

In addition to visits and consultations, gastroenterologists routinely perform endoscopies (see Table 3-14). Not surprisingly, gastroenterologists spend about the same amount of time on initial office visits and initial consultations (almost an hour). As expected, gastroenterologists report that performing a biopsy during an upper GI endoscopy adds 5 minutes and increases complexity slightly. Similarly, going beyond the splenic flexure for a diagnostic fiberoptic colonoscopy adds 15 minutes (about a 50 percent time increase) and substantially increases the complexity of the procedure.

Although they perform them less frequently, other medical specialties (internists, GPs, and FPs) and general surgeons were also asked to estimate the time and complexity of some of the endoscopies for comparison. For example, all four of these specialites were asked how long it took them to perform a fiberoptic sigmoidosocopy. Each reported substantially longer times on average than the 17 minutes reported by gastroenterologists (27 by general surgeons and between 28 and 30 minutes by internists, FPs, and GPs). These differences are more likely to be explained by the relative experience in performing the procedure rather than by casemix differences.

All five specialites were also asked to rate the time and complexity of fiberoptic colonoscopies (to the splenic flexure), and diagnostic upper GIs. However, there were only small differences in the reported times. General surgeons were also asked about colonoscopies beyond the splenic flexure and reported somewhat longer times than gastroenterologists (54 minutes vs. 46). Similarly, internists, FPs, and GPs reporting on proctosigmoidoscopies reported substantially longer times than gastroenterologists (21 minutes vs. 13, respectively).

TABLE 3-14

PROCEDURE TIME AND COMPLEXITY: GASTROENTEROLOGISTS

PROCEDURES	PERFORMED AT LEAST MONTHLY N	Mean Time	Standard Deviation	N	Mean Complexity	Standard Deviation	PERFORMED LESS THAN MONTHLY N	Mean Complexity	Standard Deviation
Initial comprehensive office visit for a new patient (CPT-4 90020)	34	51.5	17.7	32	69.2	25.2	3	64.3	36.8
Initial comprehensive hospital visit, with history and examination for a new or established patient (CPT-4 90220)	34	57.2	21.1	32	70.4	24.8	3	73.3	37.9
Intermediate follow-up hospital visit (CPT-4 90260)	33	18.6	9.3	30	39.5	21.9	4	35.8	31.8
Initial comprehensive consultation (CPT-4 90620)	34	57.8	27.7	32	73.3	24.4	2	84.0	19.8
Interpretation and report (only) for a chest X-ray with two views (CPT-4 71020)	9	7.0	5.7	9	27.2	17.3	20	30.3	20.8
Interpretation and report (only) for an ECG (electrocardiogram) (CPT-4 93010)	19	6.6	4.2	19	20.5	15.0	12	40.8	21.7
Interpretation and report (only) for an abdominal ultrasound (CPT-4 76700)	9	10.2	6.3	9	41.1	18.8	18	37.9	22.2
Interpretation and report (only) for an upper GI series (CPT-4 74240)	12	16.4	9.5	12	44.1	26.5	18	37.9	19.9
Diagnostic proctosigmoidoscopy (CPT-4 45300)	27	13.0	7.3	26	29.0	21.2	8	36.9	19.1
Diagnostic flexible fiberoptic sigmoidoscopy (CPT-4 45330)	33	16.9	9.7	31	38.5	22.6	3	65.0	15.0
Diagnostic, fiberoptic colonoscopy, 25 cm to splenic flexure (CPT-4 45360)	28	33.4	15.0	26	56.5	21.9	8	81.0	21.8
Diagnostic, fiberoptic colonoscopy, beyond splenic flexure (CPT-4 45378)	34	48.1	21.5	32	98.9	4.7	2	77.5	31.8
Diagnostic upper GI endoscopy, complex, without biopsy (including the esophagus, stomach and either the duodenum and/or the jejunum) (CPT-4 43235)	35	26.2	16.7	33	65.4	19.6	1	55.0	--
Upper GI endoscopy for biopsy (CPT-4 43239)	35	31.5	17.7	33	69.2	20.4	1	65.0	--

Source: Data shown here were obtained from the 1987 Physicians' Practice Follow-up Survey.

3.2.13 Neurology

Compared to other specialists, neurologists spend somewhat more time with patients during their office and hospital visits and rate these visits as being considerably more complex. It is possible that this reflects a real difference in visit content. Indeed, visits and consultations have an average complexity rating of about 90 (see Table 3-15). Interestingly, neurologists even rate visits as considerably more complex than the relatively new technology of magnetic resonance imaging. This new technology also takes only a couple more minutes than CAT scans without contrast, although it is rated as more complex.

Neurologists spend the same amount of time as neurosurgeons interpreting and reporting on EEGs, but spend about twice as much time on skull X-rays and lumbar punctures.

3.2.14 Dermatology

Most dermatologists performed all of the procedures shown on Table 3-16 at least monthly, except for initial hospital visits and excisions of benign lesion on trunk, arms, or legs (3.0 to 4.0 cm). These latter two procedures were also considered the most time consuming on the list, while the larger facial excisions (1.0 to 2.0 cm) were considered to be the most complex. In contrast to plastic surgeons, dermatologists' complexity ratings for lesions increase more with the lesion size rather than site.

3.2.15 Radiology

Table 3-17 presents mean time and complexity estimates for 22 different radiologic services. Those services marked by an "a" were asked of all 250 radiologists participating in the 1987 Physicians' Practice Follow-up Survey. The remaining services were divided into two groups (denoted with a "b" or "c"), with one-half of the sampled radiologists reporting on each group. Most of the services shown on Table 3-17 were performed at least monthly by the majority of radiologists. The two ophthalmic ultrasound procedures (76516 and 76517) are notable exceptions; almost none of the radiologists surveyed performed these services with any frequency. (This was validated by BMAD claims data; less than one-half of one percent of all bills for ophthalmic scans were submitted by radiologists.) In addition, daily simple megavoltage treatment, the only therapeutic radiology procedure on the list is performed at least monthly by only 20 radiologists.

TABLE 3-15

PROCEDURE TIME AND COMPLEXITY: NEUROLOGISTS

PROCEDURES	PERFORMED AT LEAST MONTHLY						PERFORMED LESS THAN MONTHLY		
	N	Mean Time	Standard Deviation	N	Mean Complexity	Standard Deviation	N	Mean Complexity	Standard Deviation
Initial comprehensive office visit for a new patient (CPT-4 90020)	35	60.0	16.3	33	88.3	14.0	1	80.0	--
Initial comprehensive hospital visit, with history and examination for a new or established patient (CPT-4 90220)	33	62.1	18.2	32	90.7	13.4	2	77.5	3.5
Initial comprehensive consultation (CPT-4 90620)	35	57.6	18.1	33	90.0	16.2	1	65.0	--
Interpretation and report (only) for a chest X-ray with two views (CPT-4 71020)	2	3.0	0.0	2	10.0	0.0	30	26.4	17.1
Interpretation and report (only) for a spine X-ray--lumbosacral, anteroposterior, and lateral (CPT-4 72100)	6	9.8	3.5	6	45.0	15.2	27	33.5	17.7
Interpretation and report (only) for an EEG--awake, drowsy, and asleep (CPT-4 95819)	30	13.6	6.6	28	49.9	22.5	6	35.0	24.1
Interpretation and report (only) for a complete skull X-ray with a minimum of four views (CPT-4 70260)	4	11.3	4.8	4	51.3	25.3	29	37.2	26.0
Magnetic resonance imaging; brain (CPT-4 70550)	4	16.3	4.8	4	71.3	17.5	30	64.2	25.1
CAT scan of head without contrast (CPT-4 70450)	6	14.2	8.6	6	57.5	23.6	28	52.0	24.4
CAT scan of head with and without contrast (CPT-4 70470)	7	23.6	20.8	7	68.6	17.7	27	52.2	24.4
Diagnostic, lumbar puncture (LP) (CPT-4 62270)	29	28.3	13.8	28	57.5	28.2	6	67.5	18.9
Nerve conduction, velocity, and/or latency study (motor) (CPT-4 95900)	17	29.7	17.9	17	58.5	23.0	17	62.2	29.0
Electromyography of one extremity (CPT-4 95860)	16	34.1	17.4	17	76.5	21.1	16	67.0	28.9

Source: Data shown here were obtained from the 1987 Physicians' Practice Follow up Survey.

TABLE 3-16

PROCEDURE TIME AND COMPLEXITY: DERMATOLOGISTS

PROCEDURES	PERFORMED AT LEAST MONTHLY						PERFORMED LESS THAN MONTHLY		
	N	Mean Time	Standard Deviation	N	Mean Complexity	Standard Deviation	N	Mean Complexity	Standard Deviation
Initial comprehensive office visit for a new patient (CPT-4 90020)	23	25.2	13.5	20	71.8	31.3	2	70.0	28.3
Initial comprehensive hospital visit, with history and examination for a new or established patient (CPT-4 90220)	12	39.2	16.2	12	77.5	28.2	10	75.9	32.4
Intermediate follow-up office visit for an established patient (CPT-4 90060)	25	13.3	4.4	22	38.0	21.8	1	25.0	--
Initial comprehensive consultation (CPT-4 90620)	20	27.4	10.2	17	83.2	19.5	4	73.8	25.6
Interpretation and report (only) for a chest X-ray with two views (CPT-4 71020)	0	--	--	--	--	--	14	39.1	30.7
Biopsy of skin, or subcutaneous tissue and/or mucous membrane (CPT-4 11100)	25	13.7	8.4	22	49.1	23.7	1	50.0	--
Excision of benign lesion on trunk, arms, or legs--1.0 to 2.0 cm (CPT-4 11402)	24	29.2	18.5	22	57.5	25.1	1	50.0	--
Excision of benign lesion on trunk, arms, or legs--3.0 to 4.0 cm (CPT-4 11404)	12	47.9	27.3	11	81.8	19.8	11	88.4	11.6
Excision of benign lesion on face, ears, eyelids, nose, or lips--0.5 to 1.0 cm (CPT-4 11441)	25	25.8	14.2	23	77.7	22.5	--	--	--
Excision of benign lesion of face, ears, eyelids, nose, or lips--1.0 to 2.0 cm (CPT-4 11442)	20	35.1	21.2	18	89.4	18.1	4	93.5	12.3
Destruction of facial lesion by any method including local anesthesia (CPT-4 17000)	23	13.1	9.5	20	52.2	29.3	1	60.0	--

Source: Data shown here were obtained from the 1987 Physicians' Practice Follow-up Survey.

TABLE 3-17

PROCEDURE TIME AND COMPLEXITY: RADIOLOGISTS

PROCEDURES	PERFORMED AT LEAST MONTHLY						PERFORMED LESS THAN MONTHLY		
	N	Mean Time	Standard Deviation	N	Mean Complexity	Standard Deviation	N	Mean Complexity	Standard Deviation
Interpretation and report (only) for a chest X-ray with a single view (CPT-4 71010)[a]	210	4.1	3.6	199	39.5	25.1	14	36.2	24.0
Interpretation and report (only) for a chest X-ray with two views(CPT-4 71020)[a]	218	4.7	3.9	205	43.5	25.4	11	29.5	15.2
Interpretation and report (only) of complete skull X-ray, with a minimum of four views (CPT-4 70260)[b]	111	5.9	5.2	106	42.8	22.1	8	40.6	17.4
Interpretation and report (only) for a complete hip X-ray -- unilateral, with a minimum of two views (CPT-4 73510)[b]	116	4.9	4.3	110	31.9	19.5	4	31.3	20.2
Interpretation and report (only) for a knee X-ray with two views (CPT-4 73560)[c]	96	4.0	2.8	90	21.4	16.6	12	32.1	9.6
Interpretation and report (only) for a spine X-ray -- lumbosacral, anteroposterior, and lateral (CPT-4 72100)[c]	100	6.0	3.9	94	38.8	19.3	8	35.6	17.8
Interpretation and report (only) for a complete sinus X-ray, with a minimum of 3 views (CPT-4 70220)[c]	100	5.4	4.0	94	36.8	18.2	8	41.3	13.6
Interpretation and report (only) for a bilateral mammogram (CPT-4 76091)[c]	92	9.7	6.4	87	72.9	23.4	15	64.0	20.7
Interpretation and report (only) for an upper GI series (CPT-4 74240)[c]	94	12.3	7.3	88	58.1	21.6	14	55.7	14.8
Barium enema (CPT-4 74270)[b]	113	22.4	13.2	110	68.9	20.0	4	80.0	24.5
Interpretation and report (only) for an oral contrast cholecystography (CTP-4 74290)[b]	92	8.5	7.5	88	36.9	19.4	26	32.0	23.1
Intravenous urography (pyelography) (CPT-4 74400)[a]	209	26.2	16.9	199	64.9	20.1	16	52.8	14.0
Interpretation and report (only) for an abdominal ultrasound (CPT-4 76700)[a]	95	12.2	8.6	92	78.4	20.6	14	57.1	28.2
Ophthalmic biometry by A-mode ultrasound echography (CPT-4 76516)[b]	2	20.0	14.1	2	65.0	7.1	42	67.4	25.1
Ophthalmic biometry by B-scan and/or real time ultrasound echography (CPT-4 76517)[b]	3	21.7	10.4	3	71.7	2.9	42	67.0	24.7
Daily simple megavoltage treatment (CPT-4 77400)[a]	20	17.6	16.8	14	58.2	31.7	98	68.6	26.7
Bone imaging of whole body (CPT-4 78306)[a]	154	25.7	31.8	143	56.4	19.6	58	55.7	22.0
Cat scan of head, without contrast (CPT-4 70450)[b]	91	16.3	13.3	86	74.7	18.8	19	76.1	20.9
Cat scan of head, with and without contrast (CPT-4 70470)[a]	173	22.6	18.0	165	78.2	19.1	39	79.1	17.9
Cat scan of abdomen with contrast (CPT-4 74160)[c]	83	27.3	1.1	79	82.7	16.7	19	85.3	12.5
Cat scan of abdomen with and without contrast (CPT-4 74170)[c]	74	34.4	22.4	70	87.0	15.5	28	86.0	18.5
Magnetic resonance imaging of head (CPT-70550)[a]	42	33.1	24.4	41	94.4	10.6	135	88.4	15.5

[a]Procedures were included in lists for both radiologist groups.
[b]Procedures were included in list for radiologists in group 1 only.
[c]Procedures were included in list for radiologists in group 2 only.

Source: Data shown here were obtained from the 1987 Physicians' Practice Follow-up Survey.

None of the radiologic services shown on Table 3-17 are particularly time-consuming. The longest procedures take 25-30 minutes to perform, such as bone imaging, magnetic resonance imaging (MRI), and CAT scans of the abdomen. Many services involving only interpretation and report take less than 10 minutes; interpretation of chest, knee, and hip x-rays are particularly quick, averaging less than five minutes.

Not surprisingly, given that it is a very new technology, MRI was ranked as the most complicated radiologic service to perform. CAT scans of the abdomen, followed by those of the head, were the next most complex. Knee x-rays were judged to be the least complex service.

3.3 Comparing Procedure and Pre- and Postoperative Time Estimates for Surgical Procedures

Because physicians' fees for surgical procedures often include more than simply operative services, it is important to consider the time they spend on pre- and postoperative services that may also be included in their global fee. As noted in Chapter 2.0, physicians were only asked to report in-hospital time spent on pre-operative services. To the extent that these services are performed on an outpatient basis, but still included in the bill, these time estimates may be underestimated.

It is far more likely that reported pre-and postoperative times are overestimates of the services included in the physician's global fee. This is because physicians reporting longer pre- and postoperative times may be seeing sicker patients for whom longer and more extensive care is necessary. Time spent on unrelated care or complications is likely to be billed separately. More importantly, our global fee analysis has shown that some physicians do not include all post-hospital visits in their bills for some services (Rosenbach, 1988). For these reasons, it is very important that the mean times presented in this section be interpreted cautiously with respect to what is included in physicians' "global" fees.

Table 3-18 shows mean pre-operative, operative, postoperative, and post-hospital times by specialty for most of the surgical procedures included in the Follow-up Survey. (Endoscopies are not shown here because physicians were not asked to report pre- and postoperative times for these relatively simple surgical procedures.) Standard deviations are presented below mean times in parentheses.

Looking at procedures performed by general surgeons, it is clear that operative times are generally the longest, followed by postoperative and then post-hospital times across procedures.* For example, partial colectomies have

*In fact, across all specialties, the correlation between times for the surgery and pre/post operative care was very high ($r = 0.86$, $p < 0.0001$).

TABLE 3-18

PRE-OPERATIVE, OPERATIVE, POST-OPERATIVE AND POST-HOSPITAL SURGERY TIMES BY SPECIALTY

	MEAN PROCEDURE TIME[a]			
	Pre-Operative	Operative	Post-Operative	Post-Hospital
GENERAL SURGEONS				
Permanent pacemaker insertion--dual chamber, AV sequential (CPT-4 33208)	31 (17)	79 (23)	46 (23)	36 (42)
Inguinal hernia repair (CPT-4 49505)	33 (30)	56 (24)	37 (35)	36 (27)
Carotid thromboendarterectomy (CPT-4 35301)	55 (17)	93 (25)	88 (43)	49 (24)
Partial colectomy (CPT-4 44140)	71 (54)	130 (39)	128 (109)	75 (61)
Modified radical mastectomy (CPT-4 19240)	64 (46)	109 (35)	96 (68)	87 (73)
Cholecystectomy with exploration of common duct (CPT-4 47610)	56 (38)	112 (35)	111 (81)	71 (68)
Cholecystectomy without common duct exploration (CPT-4 47600)[b]	46 (28)	75 (28)	86 (61)	58 (53)
Excision of benign lesion on trunk, arms, or legs--1.0 to 2.0 cm (CPT-4 11402)[b]	15 (19)	28 (16)	17 (23)	23 (22)
Excision of benign lesion on trunk, arms, or legs--3.0 to 4.0 cm (CPT-4 11404)	17 (19)	37 (19)	21 (25)	30 (26)
Total abdominal hysterectomy (CPT-4 58150)[b]	41 (26)	91 (29)	58 (36)	44 (27)
OBSTETRICIAN/GYNECOLOGISTS				
Total abdominal hysterectomy (CPT-4 58150)	30 (26)	91 (28)	90 (67)	48 (39)
Vaginal hysterectomy (CPT-4 58260)	33 (25)	69 (28)	83 (62)	47 (35)
Vaginal hysterectomy with plastic repair (CPT-4 58265)	36 (29)	105 (28)	93 (77)	50 (40)
Diagnostic D & C (CPT-4 58120)	18 (16)	20 (16)	18 (21)	22 (15)

[a]Mean times are shown only for physicians performing the procedures at least monthly. Standard deviations are shown in parentheses below each time.

[b]Only one-half of the original general surgeon sample was asked to report times for these procedures so that the number of different procedures included in the survey could be maximized (see page 2-8). Table 3-5 shows the sample sizes underlying the operative times shown there.

Source: Data shown here were obtained from the 1987 Physicians' Practice Follow-up Survey.

TABLE 3-18 (continued)

PRE-OPERATIVE, OPERATIVE, POST-OPERATIVE AND POST-HOSPITAL SURGERY TIMES BY SPECIALTY

	MEAN PROCEDURE TIME[a]			
	Pre-Operative	Operative	Post-Operative	Post-Hospital
ORTHOPEDIC SURGEONS				
Simple hip arthroplasty (total hip replacement) (CPT-4 27130)	42 (38)	127 (42)	122 (81)	85 (62)
Secondary hip revision (CPT-4 27135)	43 (36)	183 (72)	128 (112)	113 (79)
Total knee replacement (CPT-4 27447)	40 (33)	121 (45)	117 (75)	86 (59)
Femoral fracture with internal fixation (CPT-4 27236)	50 (31)	99 (36)	107 (79)	85 (60)
Intertrochanteric or pertrochanteric femur fracture with internal fixation (CPT-4 27244)	51 (36)	92 (38)	109 (80)	88 (60)
Hemilaminectomy for excision of a herniated disk and/or de-compression of a nerve root--lumbar unilateral (CPT-4 63030)	63 (72)	108 (63)	81 (78)	85 (71)
NEUROSURGEONS				
Carotid thromboendarterectomy (CPT-4 35301)	94 (37)	113 (39)	120 (52)	103 (49)
Hemilaminectomy for excision of a herniated disk and/or decompression of a nerve root--lumbar unilateral (CPT-4 63030)	80 (55)	89 (26)	97 (69)	91 (61)
Lumbar laminectomy for decompression of the spinal cord (CPT-4 63005)	106 (73)	137 (53)	126 (107)	109 (80)
Craniectomy or craniotomy for evacuation of a hematoma (CPT-4 61310)	73 (57)	125 (61)	169 (139)	92 (56)
Craniectomy for excision of a brain tumor--supratentorial (CPT-4 615100)	112 (73)	216 (55)	201 (156)	130 (91)

[a]Mean times are shown only for physicians performing the procedures at least monthly. Standard deviations are shown in parentheses below each time.

Source: Data shown here were obtained from the 1987 Physicians' Practice Follow-up Survey.

TABLE 3-18 (continued)

PRE-OPERATIVE, OPERATIVE, POST-OPERATIVE AND POST-HOSPITAL SURGERY TIMES BY SPECIALTY

	MEAN PROCEDURE TIME[a]			
	Pre-Operative	Operative	Post-Operative	Post-Hospital
CARDIOVASCULAR/THORACIC SURGEONS				
Permanent pacemaker insertion--single chamber, ventricular (CPT-4 33207)	50 (52)	66 (16)	55 (38)	50 (48)
Permanent pacemaker insertion--dual chamber, AV sequential (CPT-4 33208)	46 (19)	78 (41)	60 (38)	79 (65)
Carotid thromboendarterectomy (CPT-4 35301)	82 (57)	94 (33)	63 (30)	34 (25)
3 artery CABG (coronary artery bypass graft) (CPT-4 33512)	63 (42)	221 (53)	221 (119)	51 (45)
4 artery CABG (coronary artery bypass graft) (CPT-4 33513)	63 (47)	225 (25)	245 (129)	63 (47)
Aortic valve replacement (CPT-4 33405)	56 (37)	201 (57)	227 (107)	51 (59)
Lung lobectomy (CPT-4 32480)	91 (51)	145 (30)	150 (74)	107 (93)
CARDIOLOGISTS				
Permanent pacemaker insertion--single chamber, ventricular (CPT-4 33207)	53 (31)	69 (28)	80 (66)	46 (27)
Permanent pacemaker insertion--dual chamber, AV sequential (CPT-4 33208)	72 (43)	99 (37)	98 (84)	48 (21)
UROLOGISTS				
Transurethral resection of the prostate (TURP) (CPT-4 52601)	43 (37)	68 (25)	84 (53)	75 (59)
Suprapubic prostatectomy (CPT-4 55821)	58 (53)	70 (31)	124 (84)	110 (102)

[a]Mean times are shown only for physicians performing the procedures at least monthly. Standard deviations are shown in parentheses below each time.

Source: Data shown here were obtained from the 1987 Physicians' Practice Follow-up Survey.

TABLE 3-18 (continued)

PRE-OPERATIVE, OPERATIVE, POST-OPERATIVE AND POST-HOSPITAL SURGERY TIMES BY SPECIALTY

	MEAN PROCEDURE TIME[a]			
	Pre-Operative	Operative	Post-Operative	Post-Hospital
PLASTIC SURGEONS				
Biopsy of skin, or subcutaneous tissue and/or mucous membrane (CPT-4 11100)	12 (13)	25 (16)	13 (17)	21 (21)
Excision of benign lesion on trunk, arms, or legs--1.0 to 2.0 cm (CPT-4 11402)	13 (14)	31 (15)	15 (16)	23 (25)
Excision of benign lesion on trunk, arms, or legs--3.0 to 4.0 cm (CPT-4 11404)	18 (19)	46 (21)	18 (18)	25 (28)
Excision of benign lesion on face, ears, eyelids, nose, or lips--0.5 to 1.0 cm (CPT-4 11441)	13 (13)	37 (23)	15 (17)	21 (20)
Excision of benign lesion of face, ears, eyelids, nose, or lips--1.0 to 2.0 cm (CPT-4 11442)	12 (13)	45 (25)	16 (18)	25 (26)
Split graft of trunk, scalp, arms, legs, hands, or feet--up to 100 sq. cm (CPT-4 15100)	32 (20)	83 (37)	98 (77)	73 (71)
Adjacent tissue transfer or rearrangement of eyelids, nose, ears, or lips--up to 10 sq. cm (CPT-4 14060)	25 (18)	80 (26)	45 (43)	61 (61)
DERMATOLOGISTS				
Biopsy of skin, or subcutaneous tissue and/or mucous membrane (CPT-4 11100)	9 (9)	14 (8)	8 (10)	7 (9)
Excision of benign lesion on trunk, arms, or legs--1.0 to 2.0 cm (CPT-4 11402)	13 (14)	29 (19)	12 (11)	11 (11)
Excision of benign lesion on trunk, arms, or legs--3.0 to 4.0 cm (CPT-4 11404)	20 (25)	48 (27)	14 (15)	16 (15)
Excision of benign lesion on face, ears, eyelids, nose, or lips--0.5 to 1.0 cm (CPT-4 11441)	9 (9)	26 (14)	12 (12)	12 (15)
Excision of benign lesion of face, ears, eyelids, nose, or lips--1.0 to 2.0 cm (CPT-4 11442)	10 (10)	35 (21)	11 (11)	14 (18)

[a]Mean times are shown only for physicians performing the procedures at least monthly. Standard deviations are shown in parentheses below each time.

Source: Data shown here were obtained from the 1987 Physicians' Practice Follow-up Survey.

TABLE 3-18 (continued)

PRE-OPERATIVE, OPERATIVE, POST-OPERATIVE AND POST-HOSPITAL SURGERY TIMES BY SPECIALTY

	MEAN PROCEDURE TIME[a]			
	Pre-Operative	Operative	Post-Operative	Post-Hospital
OPHTHALMOLOGISTS				
Intracapsular lens extraction (CPT-4 66920)	38 (32)	55 (24)	28 (30)	126 (105)
Extracapsular lens extraction without IOL implant (CPT-4 66940)	41 (32)	48 (15)	43 (34)	106 (108)
Extracapsular lens extraction with IOL implant (CPT-4 66984)	32 (29)	56 (27)	31 (41)	112 (89)
Insertion of an IOL subsequent to extraction (CPT-4 66985)	33 (31)	40 (22)	29 (34)	114 (92)
Fistulization of sclera (CPT-4 66170)	33 (31)	60 (45)	20 (23)	126 (136)
Vitrectomy, mechanical (CPT-4 67036)	40 (39)	81 (67)	41 (37)	158 (45)
Scleral buckling (CPT-4 67107)	45 (16)	130 (49)	68 (26)	135 (70)
EARS, NOSE, AND THROAT SPECIALISTS				
Tympanoplasty (without mastoidectomy) (CPT-4 69631)	33 (32)	91 (38)	38 (27)	78 (58)
Tonsillectomy for patient under age 12 (CPT-4 42825)	19 (16)	38 (16)	25 (17)	25 (17)
Planned tracheostomy (CPT-4 31600)	28 (8)	35 (20)	53 (32)	52 (50)

[a]Mean times are shown only for physicians performing the procedures at least monthly. Standard deviations are shown in parentheses below each time.

Source: Data shown here were obtained from the 1987 Physicians' Practice Follow-up Survey.

the longest operating time (over 2 hours) of all the procedures shown for general surgeons. They also require the most pre- and postoperative time (71 minutes of in-hospital pre-operative care, 128 minutes of in-hospital postoperative care, and 75 minutes of post-hospital care). At the other extreme, small lesion excisions require the least time for both operative and pre/post operative care.

Standard deviations around pre- and postoperative times are generally smaller than the mean (except for the excisions), but are quite a bit larger than standard deviations for operative times. This trend can be seen for all the pre- and postoperative times shown here, regardless of specialty. Greater variation among physicians in the time they spend on pre- and postoperative cares is to be expected give the greater flexibility of physicians to delegate these services.

Pre-operative times are naturally the shortest since patients generally are operated on relatively soon after admission; they vary from 15 minutes for the excision of a small benign lesion to over an hour for partial colectomies and modified radical mastectomies for general surgeons. Postoperative times in the hospital tend to be the longest, and appear to be especially correlated with operating times. This is the period of time in which surgeons are most needed to check wounds, drainage, etc.

Post discharge follow-up times tend to be shorter than those in the hospital, but this varies by procedure and specialty. General surgeons spend only 49 minutes on post-hospital care for a carotid thromboendarterectomy compared to 88 minutes on postoperative follow-up in the hospital, probably because cardiologists are providing part of follow-up care.

Turning to the surgeries performed by OBGYNs, we find that among the hysterectomies, the correlation between operative and non-operative times does not seem so apparent as it did among procedures shown for general surgeons. Although OBGYNs report that plastic repair adds 36 minutes to the operation time of a vaginal hysterectomy, pre- and postoperative times are unaffected. Follow-up times for total abdominal hysterectomies are also similar to those for vaginal hysterectomies.

The mean postoperative time reported by OBGYNs for the abdominal hysterectomy is over 30 minutes longer than the one reported by general surgeons (90 minutes versus 58), possibly due to casemix differences between the two surgical specialties or perhaps because general surgeons are more likely to delegate some of the postoperative care to a medical specialist. However, they do not appear to delegate any more post-hospital services than OBGYNs for this operation; both specialties show about 45 minutes of post-hospital care for abdominal hysterectomies.

Although orthopedic surgeons report more post-hospital visits than do general surgeons and OBGYNs (Rosenbach, 1988), their postoperative and post-hospital times do not appear to be longer relative to operative times.

While the average operating times for these two procedures are more than 20 minutes shorter than hip and knee replacements, they require about the same amount of time for post-hospital care.

Neurosurgeons appear to spend more time on pre- and postoperative activities relative to operative time than do other surgeons. In fact, out of the five procedures show, neurosurgeons spend more time on postoperative care than on operative care for three procedures: carotid thromboendarterectomies, hemilaminectomies and craniectomies for the evacuation of the hematoma. Although they take less time on hemilaminectomies in the operating room than orthopedic surgeons, they spend more time on care in all the pre- and postoperative categories. This may reflect more delegation of non-operative care to other physicians on the part of orthopedic surgeons. With shorter postoperative times for carotid thromboendarterectomy, both general surgeons and cardiovascular/thoracic surgeons appear to delegate more to medical specialists than do neurosurgeons. Given the complex nature of the operations they are performing, it is not surprising to find neurosurgeons spending up to five hours in postoperative care for brain surgery.

Consistent with a lower average number of post-hospital visits than other surgeons (based on our global fee analysis), cardiovascular/thoracic surgeons report much shorter post-hospital times relative to operative times than other specialities. For example, while they spend well over six hours on operative and postoperative care in the hospital for CABGs and aortic valve replacements, they spend only about one hour on post-hospital care for these procedures. This is even less post-hospital time than they spend for the simpler dual chamber pacemaker insertion. Again, these differences probably reflect referral patterns to medical specialists for follow-up care.

As expected, given its greater complexity, cardiologists report slightly longer pre- and postoperative times for insertion of the dual chamber device than for a single chamber pacemaker (72 versus 53 minutes pre-operative and 98 versus 80 minutes postoperative). Post-discharge times for the two procedures were nearly identical (about 47 minutes).

Urologists reported spending considerably more time in postoperative follow-up for TURPs and suprapubic prostatectomies than in the OR itself. Although both operations take slightly over an hour to perform, the suprapubic prostatectomy requires much more postoperative time than does TURP.

Like general surgeons, plastic surgeons spend little follow-up time on lesion excisions and the skin biopsy. However, the more complex split graft and tissue transfer procedures require much more pre- and postoperative time by plastic surgeons.

Just as procedure times reported by dermatologists for the skin biopsy and lesion excisions are generally shorter than those reported by plastic

surgeons, pre- and postoperative times are also shorter. Again, this probably reflects different patient casemix for the two specialties.

The distinctive features of the pre- and postoperative times shown for ophthalmologists are the relatively short postoperative times and long post-hospital times. In fact, in hospital postoperative times for most of the procedures shown are almost as short as pre-operative times, if not shorter. The short amount of time spent on postoperative care reflects the technological advances in this field that have improved outcomes for lens extractions and reduced the risk involved in eye surgery in general. Long post-hospital visits for this specialty reflect the longer healing process for these surgeries as well as the inability for ophthalmologists to delegate eye care to other medical specialists.

Ear, nose and throat specialists also spend remarkably little time (only 38 minutes) on postoperative care for tympanoplasty, given its long operative time (91 minutes). Little time is spent on both in-hospital postoperative care and post-hospital care for pediatric tonsillectomies. This probably reflects the routine nature of the procedure, and the ability of these surgeons to delegate much of the follow-up care.

3.4 Time and Complexity Estimates for Anesthesiologists

Table 3-19 shows mean procedure time and complexity estimates for seventeen procedures performed by anesthesiologists. Pre- and postoperative time estimates are also shown. During the survey, anesthesiologists were randomly divided into two groups to increase the number of procedures. The full sample of anesthesiologists was asked to provide time and complexity estimates for procedures designated with an "a" in Table 3-19. Only half the sample was asked to provide estimates for procedures designated with a "b" or "c."

Anesthesiologists performed most of the procedures listed in Table 3-19 at least once a month (note the sample sizes for the complexity estimates). Exceptions include general anesthesia for some of the more complex, and less frequently performed surgeries such as secondary hip revisions, CABGs, aortic valve replacements, and suprapubic prostactectomies. Most anesthesiologists in our sample reported using a spinal block for a vaginal hysterectomy less than once a month, but general anesthesia at least monthly.

Not surprisingly, operative anesthesia times are generally longer than surgery times in the OR. For the shorter operations (involving about an hour of surgery time) such as inguinal hernia repairs, TURPs, and lens extractions, the anesthesia time is on the order of 20 minutes longer (75 minutes for the

TABLE 3-19

PROCEDURE TIME AND COMPLEXITY: ANESTHESIOLOGISTS*

PROCEDURES	PERFORMED AT LEAST MONTHLY					PERFORMED LESS THAN MONTHLY	
	Mean Time			Complexity		Complexity	
	Pre-Operative	Operative	Post-Operative	N	Mean	N	Mean
Interpretation and report (only) for a chest X-ray with two views (CPT-4 71020)[a]	--	6 (6)	--	61	23 (20)	134	20 (17)
General anesthesia for a transurethral resection of the prostate (TURP) (CPT-4 52601)[a]	18 (11)	90 (24)	18 (21)	171	52 (20)	54	57 (20)
Spinal block for a transurethral resection of prostate (TURP) (CPT-4 52601)[c]	18 (11)	85 (39)	19 (24)	89	47 (20)	21	49 (19)
General anesthesia for a simple hip arthroplasty (total hip replacement) (CPT-4 27130)[a]	19 (11)	164 (58)	19 (16)	164	66 (21)	60	69 (19)
General anesthesia for a secondary hip revision (CPT-4 27135)[c]	19 (12)	175 (74)	19 (18)	35	68 (21)	74	65 (17)
General anesthesia for a femoral fracture with internal fixation (CPT-4 27236)[a]	19 (12)	115 (43)	17 (12)	159	63 (19)	66	59 (19)
General anesthesia for a 3-artery CABG (coronary artery bypass graft) (CPT-4 33512)[a]	29 (15)	293 (71)	34 (31)	63	95 (10)	150	93 (13)
General anesthesia for an aortic valve replacement (CPT-4 33405)[c]	34 (17)	261 (77)	35 (32)	27	95 (9)	75	97 (8)
General anesthesia for an inguinal hernia repair (CPT-4 49505)[c]	16 (10)	75 (29)	18 (19)	100	32 (18)	10	38 (18)
General anesthesia for a hemilaminectomy for excision of a herniated disk and/or decompression of a nerve root -- lumbar unilateral (CPT-4 63030)[c]	19 (16)	134 (40)	20 (21)	83	66 (19)	26	66 (17)
General anesthesia for cholecystectomy with common duct exploration (CPT-4 47610)[c]	19 (15)	119 (41)	20 (22)	90	58 (19)	19	59 (15)
General anesthesia for a suprapubic prostatectomy (CPT-4 55821)[b]	18 (8)	124 (41)	17 (13)	33	57 (23)	81	65 (21)
Monitored anesthesia care for a lens extraction with IOL implant (CPT-4 66984)[b]	17 (12)	82 (30)	14 (13)	85	49 (23)	30	52 (24)
General anesthesia for a total abdominal hysterectomy (CPT-4 58150)[b]	17 (8)	112 (29)	17 (15)	97	54 (19)	18	56 (23)
General anesthesia for a vaginal hysterectomy (CPT-4 58260)[b]	16 (8)	101 (33)	16 (15)	83	48 (18)	32	57 (23)
Spinal block for a vaginal hysterectomy (CPT-4 58260)[b]	16 (8)	96 (40)	17 (15)	34	57 (21)	80	48 (19)
General anesthesia for a partial colectomy (CPT-4 44140)[b]	19 (9)	155 (43)	19 (17)	99	69 (18)	16	58 (21)

*Standard deviations are shown below means in parentheses.
[a]Procedures were included in lists for both anesthesiologist groups.
[b]Procedures were included in list for anesthesiologists in group 1 only.
[c]Procedures were included in list for anesthesiologists in group 2 only.

Source: Data shown here were obtained from the 1987 Physicians' Practice Follow-up Survey.

hernia repair, 85 or 90 minutes for the TURP depending on whether it is regional or general, and 82 minutes for the lens extraction). More complex operations requiring over 3 hours of surgery time (e.g., CABGs and aortic valve replacements) require between 4 and 5 hours of operative anesthesia time. Regional anesthsia appears to take about five minutes less than general anesthesia for both the TURP and vaginal hysterectomy.

Mean pre-operative and postoperative anesthesia times are much smaller than operative times and nearly identical for any one procedure. Pre-operative times average 16-19 minutes except for open-heart surgery which involves about one-half hour of pre-anesthetic evaluation and preparation. Postoperative times range from 14 minutes for the lens extraction with IOL implant to 35 minutes for the aortic valve replacement, but again most procedures involve less than 20 minutes of follow-up care.

Complexity estimates for anesthesia services appear to be highly correlated with the time requirements. The longest operations (CABGs and aortic valve replacements) are also rated the most complex (95 by anesthesiologists providing anesthesia for these surgeries at least once a month). Among the least complex are the shorter and more routine procedures such as anesthesia for TURPs, hernia repairs and lens extractions. Providing regional anesthesia for a TURP is considered slightly less complex than providing general anesthesia (rated only 47 compared to 52 for general anesthesia). By contrast, administering general anesthesia is considered to be slightly less difficult than providing a spinal block for a vaginal hysterectomy by anesthesiologists performing these procedures at least monthly.

Anesthesiologists are excluded from the analyses presented in Chapters 4 and 5. The times reported in Table 3-19 are for anesthesiologists personally performing the anesthesia. However, Medicare pays differentially when anesthesiologists perform the complete procedure from when they medically direct Certified Registeredd Nurse Anesthetists (CRNAs). Unfortunately, this distinction can not be reliably determined from claims data.

3.5 Inter-rater Reliability of Physicians' Time and Complexity Estimates

Although considerable variation in mean time and complexity estimates is to be expected, we must still be concerned about the reliability of those estimates. How likely would we be to obtain the same estimates if we asked another set of physicians the same questions?

To answer this question, we sought to measure inter-rater reliability. The two main methods available to measure reliability for these types of rating-scale evaluations include: (1) correlating the observer's (i.e., the physician's) judgements at two different times, or (2) assuming that similar judges are interchangeable and then intercorrelating their estimates (Guilford

and Fruchter, 1973). Since we do not have access to data necessary for the first method, we make the fairly plausible assumption that physicians' estimates are interchangeable within specialty and use the second method to measure reliability.

We calculated intraclass correlation coefficients, to measure the typical reliability of a single physician's time or complexity estimate. This measure provides an estimate of the reliability of the data presented in this chapter. In addition, we calculated the reliability of average time and complexity measures for the entire specialty, which yield higher levels of reliability. Calculating the reliability of the group or average ratings generates higher measures of reliability, because averaging reduces the relative importance of errors of measurement, leaving the relationships enhanced. Since we only work with average time and complexity in Chapters 4 and 5, our measures of group ratings are appropriate for the data used there.

Table 3-20 shows the typical intercorrelation of physicians' ratings with respect to time and complexity by specialty. Most of the intraclass correlation coefficients for a single physician's procedure time are greater than 0.5, suggesting a high degree of reliability overall. However, there are some systematic differences among the measures. In general, physicians' procedure time estimates are higher for surgeons than for medical specialists. This may reflect differences in the types of procedures included for these specialty groups. A larger number of procedures included in lists for medical specialties were visits and diagnostic procedures, which are less specifically-defined services, more heterogeneous, and/or more subject to inter-physician casemix variation. Additionally, in contrast to the surgical procedure lists, there is less variation in the time and complexity among procedures in the medical care procedure lists. The less distinct the procedures are from one another, the more difficult it is for the physicians to discriminate between them in terms of time, and especially complexity.

However, while surgical specialists generally tend to provide more reliable procedure time estimates than medical specialists, ophthalmologists actually provided the least reliable procedure time estimates with an intraclass correlation coefficient of only .417. This may reflect considerable variation in casemix and procedure specialization within this specialty. In particular, some ophthalmologists limit their practice to medical services only (i.e., visits), while others perform the full range of medical services and surgical procedures. The only other specialists with reliability estimate of less than .5 are radiologists. Specialists providing the most reliable procedure time estimates include cardiovascular/thoracic surgeons, neurologists, neurosurgeons and othopedic surgeons with correlation coefficients ranging between .839 and .911.

TABLE 3-20

INTRA-CLASS CORRELATION COEFFICIENTS FOR TIME AND COMPLEXITY ESTIMATES BY SPECIALTY

	PROCEDURE TIME		PRE- & POST-OP TIME		COMPLEXITY	
	Typical Physician	Specialty Average	Typical Physician	Specialty Average	Typical Physician	Specialty Average
Surgical Specialties						
Orthopedic surgeons	.839	.998	.062	.860	.727	.996
Urologists	.673	.996	.367	.986	.741	.997
Cardiovascular/thoracic surgeons	.911	.996	.769*	.995*	.711	.982
General surgeons (group 1)	.787	.997	.365	.980	.712	.995
General surgeons (group 2)	.776	.997	.520	.990	.761	.996
Ophthalmologists	.417	.987	.054	.836	.753	.997
Obstetrician/gynecologists	.793	.999	.527	.996	.750	.983
Neurosurgeons	.857	.993	.222	.868	.829	.990
Plastic surgeons	.553	.976	.462	.966	.611	.981
Ear, nose, and throat specialists	.674	.990	.342	.959	.440	.973
Medical Specialties						
General practioners	.560	.995	----	----	.433	.992
Family practitioners	.667	.998	----	----	.511	.997
Internists	.731	.999	----	----	.530	.998
Cardiologists	.728	.996	.769*	.995*	.605	.992
Gastroenterologists	.636	.985	----	----	.579	.982
Neurologists	.870	.996	----	----	.560	.979
Dermatologists	.505	.964	.222	.881	.470	.955
Other Specialties						
Radiology (group 1)	.448	.990	----	----	.524	.993
Radiology (group 2)	.438	.989	----	----	.631	.995
Anesthesiology (group 1)	.722	.997	.007	.487	.584	.994
Anesthesiology (group 2)	.822	.998	.208	.921	.678	.996

*Since the only two surgical procedures performed by cardiologists were also performed by cardiovascular/thoracic surgeons, their time estimates were pooled.

Source: Data shown here were obtained from the 1987 Physicians' Practice Follow-up Survey.

The reliability of average procedure time estimates is extremely high (above .96) for all specialties. For many specialties, the reliability of mean procedure times is nearly perfect (1.0). This suggests that while any one radiologist's, ophthalmologist's or dermatologist's procedure time estimate may not be reliable, the mean for each specialty is highly reliable.

Although individual surgeons tend to provide reliable procedure time estimates, they do not generally provide reliable pre- and postoperative time estimates. Low correlation coefficients for pre- and postoperative times probably reflect the high degree of variation among physicians in the provision of non-operative care as well as the less specifically defined nature of these services and greater casemix variation. However, low correlation coefficients may also reflect the smaller number of procedures for which this information was collected. For example, cardiologists and urologists were asked to provide time estimates for only two surgical procedures, which greatly lowers the degrees of freedom in calculating correlation coefficients. Because the surgical procedures included for cardiologists were among the surgical procedures included for cardiovascular/thoraic surgeons, we were able to calculate a correlation coefficient for these specialties jointly, thereby eliminating problems in the degrees of freedom for cardiologists.

Only the cardiovascular/thoracic surgeons (and cardiologists), obstetricians/gynecologists and one group of general surgeons provided non-operative time estimates with greater than average (.5) reliability at the individual physician level. One anesthesiologist group, ophthalmologists and orthopedic surgeons provided the least reliable non-operative time estimates, with correlation coefficients of only .007, .054 and .062.

While averaging pre- and postoperative times greatly increases the reliability of these estimates for all specialties, these latter three specialties still appear to provide the least reliable non-operative time estimates. However, aside from the one group of anesthesiologists, all of the correlation coefficients for average non-operative time are greater than .80, suggesting a high degree of reliability for the non-operative time estimates used in Chapters 4 and 5.

Reliability measures for procedure complexity estimates are comparable to those for procedure time estimates. Reliability measures for estimates at the individual physician level vary from a low of .433 for GPs to a high of .829 for neurosurgeons. In general, complexity estimates are slightly less reliable than procedure time estimates within specialty.

Given that time is a more objective measure than complexity, we would expect the intraclass correlation coefficients to be higher for time than complexity. Indeed, all the medical specialties and most surgical specialties provided more reliable procedure time estimates than complexity estimates.

However, the intraclass correlation coefficients for time estimates are lower than those for complexity for urologists (.67 vs. .74), ophthalmologists (.42 vs. .75), and plastic surgeons (.55 vs. .61). This result may reflect that the particular procedures chosen for these specialties have higher internal consistency with respect to complexity than with respect to time.

"Specialty-average" complexity estimates are very reliable for all specialties. Intraclass correlation coefficients for average complexity range from a low of .955 for dermatologists to .998 for internists.

Despite differences in the reliability of procedure time and complexity measures among the specialties, all the measures suggest a fairly high degree of individual rater reliability. This finding suggests that we may have confidence in most of the results presented in this chapter. Low reliability measures for non-operative time estimates suggest that the results for pre- and postoperative times presented in this chapter be interpreted cautiously. High reliability measures for mean procedure time and complexity estimates <u>and</u> for mean non-operative time estimates enhance the confidence in the multivariate results and predicted payments presented in the remaining chapters.

4.0 A REGRESSION-BASED APPROACH TO PREDICTING MEDICARE PAYMENTS BASED ON PHYSICIAN EFFORT

4.1 What Does "Overpriced" Mean?

Policy makers have argued that certain physician services are "overpriced" relative to the physician effort involved, particularly surgical procedures. At the same time, other services, such as office visits, may be paid too little. The very notion that Medicare is paying too much for some services and not enough for others implies that some services are reimbursed relative to effort. If so, then our analysis of the existing relationship between physician effort and allowed charges may help identify under- and overpaid procedures. On the other hand, some critics have argued that the total Medicare charge list is distorted and that every service needs to be re-priced. The Resource-Based Relative Value Scale (RBRVS) under development by Hsiao and colleagues is, of course, an attempt to do exactly this. While such a complete revision of relative payment levels may be desirable, our goal here is a more modest one: to identify those services that appear "most out of line" relative to physician effort. By "effort," we mean the time involved in performing a procedure (including time spent in pre- and post-operative care) and the relative complexity of the procedure.

We have obtained two related measures of physician effort through our physician survey: (1) the estimated time it takes to perform the service; and (2) the perceived complexity of the service. If many services are paid appropriately relative to level of effort, then a regression model that uses time and complexity to explain actual allowed charges should have good explanatory power (i.e., a high R-square) and should identify those "mispriced" procedures. To do this, of course, requires a wide array of physician services, not limited to a particular type of service (like surgery) or to a particular specialty. The regression analyses presented in chapters 4 and 5 were conducted using 17 specialties: general practice, family practice, internal medicine, cardiology, dermatology, gastroenterology, neurology, general surgery, ophthalmology, orthopedic surgery, cardiovascular/thoracic surgery, plastic surgery, otolaryngology, neurosurgery, urology, obstetrics/gynecology, and radiology.

Anesthesiologists have been excluded from the analysis since all reported time estimates were based on the physician personally performing each procedure. However, Medicare pays differentially when anesthesiologists perform the complete procedure from when they medically direct Certified Registered Nurse Anesthetists (CRNAs). Unfortunately, this distinction can not be reliably determined from claims data.

This chapter is divided into five sections. Section 4.2 provides an overview of alternative approaches to identifying mispriced procedures, and discusses advantages of our regression methodology over the index procedure

approach. Section 4.3 describes the procedures for cross-specialty analysis, including the standardization of complexity and aggregation of common procedures. Next, Section 4.4 presents in detail the methods used in our regression approach (i.e., scaling and estimation methods). Finally, the results of the regressions are discussed in Section 4.5. Chapter 5 and Appendix B present the predicted amounts that are derived from the various regression specifications. Appendix B contains computer output with both the regression results and predicted amounts.

4.2 Approaches to Identifying Mispriced Procedures

Our methodology represents a fundamental change from that used in our previous work on overpriced procedures (Mitchell et al., 1987). There, we used scale values developed elsewhere (the Resource-Based Relative Value Scale published by Hsiao and Braun). Medicare charges were transformed into payments reflecting resource costs by comparing the j-th procedure to a base or index procedure, as follows:

$$\text{Resource-based payment}_j = CHG_I * \frac{RBRVS_j}{RBRVS_I}$$

where

CHG_I = Medicare allowed charge for the index procedure;

$RBRVS_I$ = Resource-based relative value for the index procedure; and

$RBRVS_j$ = Resource-based relative value for the j-th procedure.

This approach depends critically on the choice of a base or index procedure. Results will be sensitive to the selection of this procedure, especially when comparisons are being made across different types of physician services (e.g., visits, surgery, x-rays, etc.). This approach also pre-supposes a single scale that appropriately combines time and complexity. This poses particular problems for our study since time and complexity were measured on different scales. Time was reported in minutes and complexity estimates were obtained on an arbitrary scale ranging from one to 100. Furthermore, there are no objective criteria for weighting time and complexity a priori. Should we value each one equally, for example, or should time be weighted disproportionately more than complexity in a summary scale of physician effort?

Our regression approach has several advantages. First, it eliminates the need for an index procedure. Rather than comparing relative physician effort and payment for a single procedure believed to be equitably reimbursed, the regression method compares the effort-price relationship for each service

to the average relationship. Second, this approach puts time and complexity on the same scale of measurement. We can now compare the impact of unit changes in time or complexity on payment levels. Third, the regression method eliminates the need to arbitrarily choose weights for time and complexity. The regression coefficients, of course, become the relative weights.

Some readers may question whether it is circular reasoning to use prices to identify overpaid procedures in the first place. We believe not for the following reasons. By using fee regressions, we are assuming that, on average, across all services, Medicare payment adequately reflects physician effort. Without this assumption, the whole notion of "overpriced" procedures is meaningless. One could, of course, argue that all physician services are overpaid relative to the effort involved in providing them. If so, then the regression approach (as well as the use of an index procedure) will underestimate the "true" magnitude of over- and under-payments. Nevertheless, our approach will still capture deviations in the price-effort relationship from the average, however, even if the average is biased upward. It should be pointed out that the alternative method that uses an index procedure is also based on price. It requires that one choose a single service that is believed to be appropriately reimbursed given the level of effort involved. The selection of a single service considered to correctly reflect effort in its average allowable charge is undoubtedly more arbitrary and is more subject to disagreement.

Nevertheless, in Appendix C we explicitly compare our regression-based approach with the more traditional index-based approach. This will help identify the sensitivity of our results to one methodology versus the other.

4.3 Methodology for Cross-Specialty Analysis

Before pooling time and complexity data for all specialties, however, certain adjustments had to be made. First, complexity estimates for the various specialties had to be standardized or placed on a common scale. The method for standardizing complexity is described in Section 4.3.1. Second, common procedures needed to be aggregated across specialties. There was substantial duplication of procedures, as different specialties were asked to rank some of the same procedures. This provides a link across specialties but results in the same procedure appearing several times in the data base with different times and complexity scores. Section 4.3.2 discusses the methods for combining procedures across specialties to produce a single observation for regressions analysis.

4.3.1 Standardizing for Complexity

Before specialties could be pooled for the regression analyses, it was necessary to standardize their complexity estimates. Each specialty had been asked to rank the complexity of procedures on a scale ranging from one to 100, where 100 represented the most complex procedure on that specialty's list. Since specialties generally had quite different procedure lists, this meant that a procedure with a complexity score of, say, 50 for one specialty might not be truly as complex as a procedure with an identical score reported by a different specialty. Every specialty had one procedure in common, however: the interpretation and report of a chest x-ray. We used this procedure to anchor all complexity estimates. Each complexity score for each specialty was divided by that specialty's chest x-ray score. The resulting scores thus rank complexity relative to that for chest x-ray interpretation within each specialty. For each specialty, then, the complexity score for a chest x-ray is 1.0.

Two exceptions were made in the case of routine chest x-rays for dermatologists and neurologists. Because so few neurologists interpreted chest x-rays on a monthly basis, we accepted data from infrequent performers as well, and because no dermatologists regularly interpreted x-rays, the average response for internists was used instead.

Table 4-1 compares raw (unadjusted) and standardized complexity scores for three procedures, each of which has complexity reports from several different specialties. The general impact of standardization is to compress the rankings, since they are now on a common scale. Raw scores for proctosigmoidoscopy, for example, ranged three-fold (from 22.0 to 69.8). Once each score is expressed relative to a chest x-ray, the range is much narrower, from 1.39 to 2.19.

4.3.2 Combining Common Procedures

By design, there was considerable overlap in the procedure lists for each specialty. The entire list was identical for internists, general, and family practitioners, and in other instances, time and complexity for one or two procedures might be obtained for two or more specialties. Both cardiologists and thoracic surgeons were asked to report on Swan-Ganz catheterization, for example, and general surgeons and gastroenterologists shared certain endoscopies in common with internists.

All "common" procedures were aggregated across specialties for analysis, except for visits and consultations. Medicare generally pays for surgery, x-rays, ECGs, and the like, without regard to specialty-specific fee screens.

TABLE 4-1

RAW AND STANDARDIZED COMPLEXITY RANKINGS FOR SELECTED PROCEDURES AND SPECIALTIES

Procedure/Specialty	Raw (Unadjusted) Complexity	Standardized Complexity (Chest x-ray = 1.0)
Proctosigmoidoscopy		
General Practice	69.8	2.19
Family Practice	63.2	1.99
General Surgery	22.0	1.61
Internal Medicine	58.1	1.82
Gastroenterology	38.5	1.39
Dual Chamber Pacemaker Insertion		
General Surgery	51.7	3.77
Cardiology	83.9	3.57
Thoracic Surgery	57.0	3.33
Follow-up Office Visit		
General Practice	36.0	1.13
Family Practice	35.7	1.12
Internal Medicine	41.6	1.31
Dermatology	38.0	1.37
Plastic Surgery	24.1	0.59

Source: Physicians' Practice Follow-up Survey.

A proctosigmoidoscopy, for example, is the same service regardless of what kind of physician performs it. There is no inherent reason to value this procedure differently when provided by an internist versus a family practitioner. By contrast, it is widely believed that non-procedural services, e.g., visits, represent fundamentally different products when performed by different specialists. Office visits provided by family practitioners, cardiologists, and urologists, for example, are perceived by patients as three very different services, and Medicare carriers almost always use different prevailing screens for them.*

Medicare allowed charges, reported times, and complexity estimates were combined only for the common (non-visit) procedures using the relative frequencies of performance by specialty as weights. Based on the 1985 BMAD claims data (the source of our Medicare charge data), we calculated each specialty's share (number of claims) as a percent of the procedure total.

In the one pooled regression analysis that we performed, the procedures were aggregated across medical and surgical specialties based on the weights from the BMAD claims file. However, most of our work is based on separate regression equations for medical and surgical specialists. Thus, procedures that are performed by both specialty groups are included in both regressions. In such cases, aggregation occurs within the medical and surgical specialties. Table 4-2 displays the cross-specialty procedures included in our study. These procedures have not been aggregated across specialties since most of our analysis is based on separate medical and surgical regressions. For example, both cardiologists and cardiovascular/thoracic surgeons perform a pacemaker insertion (single chamber), but these procedures have not been combined across the two groups. As shown in Table 4-2, three surgical specialties were asked to report time and complexity for a carotid thromboendarterectomy -- general surgeons, neurosurgeons, and cardiovascular/thoracic surgeons -- with general surgeons accounting for 54 percent of claims. They receive most of the weight in the aggregation across specialties.

The totals can be interpreted as the average time, average complexity, and average allowed charge for Medicare ECGs. Where a particular specialty dominates the provision of the service, its own charges and reported time and relative complexity will essentially determine the overall values for the procedure in the regression.

Radiology procedures are similarly combined across medical and surgical specialties, as shown in Table 4-3. However, in many cases, the radiologists

*This argument could certainly be extended to other services as well. When cardiologists review ECGs, for example, are they providing a qualitatively different service than when family practitioners read one? Although Medicare reimburses each the same amount (roughly $14), cardiologists report that they interpret ECGs more quickly (5 minutes versus 8 for FPs) and that they regard them as less complex than do FPs.

TABLE 4-2

PROCEDURE TIME AND COMPLEXITY BY MEDICAL AND SURGICAL SPECIALTIES

		Percent of Claims	Procedure Time[a]	Pre- & Post-Op. Time[a]	Standardized Complexity	Allowed Charge
Permanent pacemaker insertion--single chamber, ventricular (CPT-4 33207)						
Medical	Cardiologists	100%	69	180	2.68	$937.21
Surgical	Cardiovascular/Thoracic Surg.	100	66	156	1.61	1058.47
Permanent pacemaker insertion--dual chamber, AV sequential (CPT-4 33208)						
Medical	Cardologists	100	99	217	3.57	1245.92
Surgical	General Surgeons	39	79	112	3.77	1206.82
	Cardiovascular/Thoracic Surg.	61	78	185	3.33	1314.47
	TOTAL	100	78	157	3.50	1272.49
Carotid thromboendarterectomy (CPT-4 35301)						
Surgical	General Surgeons	54	93	192	7.18	1491.76
	Neurological Surgeons	12	113	316	7.37	1467.94
	Cardiovascular/Thoracic Surg.	34	94	179	4.18	1516.83
	TOTAL	100	96	202	6.18	1497.43
Diagnostic, complex upper GI endoscopy (including esophagus, stomach, and either the duodenm and/or the jejunum) (CPT-4 43235)						
Medical	General Practitioners	2	30	0	2.20	263.23
	Family Practitioners	1	23	0	2.40	250.54
	Gastroenterologists	52	26	0	2.35	292.82
	Internists	45	30	0	2.10	265.10
	TOTAL	100	28	0	2.24	279.33
Surgical	General Surgeons	100	30	0	2.70	270.66

[a]Times are reported in minutes.

Source: Actual Medicare allowed charges were obtained from 1985 BMAD claims data. Procedure time and complexity estimates were calculated from the Physicians' Practice Follow-up Survey.

TABLE 4-2 (continued)

PROCEDURE TIME AND COMPLEXITY BY MEDICAL AND SURGICAL SPECIALTIES

		Percent of Claims	Procedure Time[a]	Pre- & Post-Op. Time[a]	Standardized Complexity	Allowed Charge
Upper GI endoscopy for biopsy (CPT-4 43239)						
Medical	General Practitioners	2%	20	0	2.20	$311.86
	Family Practitioners	0	28	0	2.40	294.49
	Gastroenterologists	53	31	0	2.49	333.62
	Internists	45	31	0	2.31	309.97
	TOTAL	100	31	0	2.40	322.54
Diagnostic proctosigmoidoscopy (CPT-4 45300)						
Medical	General Practitioners	13	22	0	1.45	33.36
	Family Practitioners	13	21	0	1.48	35.23
	Gastroenterologists	11	13	0	1.04	42.35
	Internists	64	21	0	1.30	35.35
	TOTAL	100	20	0	1.31	35.86
Diagnostic, flexible fiberoptic sigmoidoscopy (CPT-4 45330)						
Medical	General Practitioners	8	29	0	2.19	73.97
	Family Practitioners	11	29	0	1.99	78.27
	Gastroenterologists	29	17	0	1.39	90.09
	Internists	52	28	0	1.82	80.38
	TOTAL	100	25	0	1.74	82.45
Surgical	General Surgeons	100	27	0	1.61	85.76
Diagnostic, fiberoptic colonoscopy, 25 cm to splenic flexure (CPT-4 45360)						
Medical	General Practitioners	9	33	0	2.36	174.11
	Family Practitioners	12	30	0	2.40	163.55
	Gastroenterologists	28	33	0	2.03	236.65
	Internists	51	34	0	2.52	189.24
	TOTAL	100	33	0	2.35	198.07
Surgical	General Surgeons	100	31	0	2.05	196.23

[a]Times are reported in minutes.

Source: Actual Medicare allowed charges were obtained from 1985 BMAD claims data. Procedure time and complexity estimates were calculated from the Physicians' Practice Follow-up Survey.

TABLE 4-2 (continued)

PROCEDURE TIME AND COMPLEXITY BY MEDICAL AND SURGICAL SPECIALTIES

		Percent of Claims	Procedure Time[a]	Pre- & Post-Op. Time[a]	Standardized Complexity	Allowed Charge
Diagnostic, fiberoptic colonoscopy, beyond the splenic flexure (CPT-4 45378)						
Medical	Gastroenterologists	100%	48	0	3.56	$390.77
Surgical	General Surgeons	100	54	0	3.42	362.45
Total abdominal hysterectomy (CPT-4 58150)						
Surgical	General Surgeons	16	91	143	4.08	797.39
	Obstetricians/Gynecologists	84	91	169	3.53	945.21
	TOTAL	100	91	165	3.62	921.56
Diagnostic lumbar punture (CPT-4 62270)						
Medical	Neurologists	100	28	0	2.18	57.43
Surgical	Neurological Surgeons	100	19	0	1.99	54.28
Hemilaminectomy for excision of a herniated disk and/or decompression of a nerve root--lumbar unilateral (CPT-4 63030)						
Surgical	Neurological Surgeons	72	89	268	5.59	1242.66
	Orthopedic Surgeons	28	108	229	5.61	1222.87
	TOTAL	100	94	257	5.60	1237.12
Interpretation and report (only) for an ECG (electrocardiogram) (CPT-4 93010)						
Medical	General Practitioners	3	8	0	1.15	12.62
	Cardiologists	48	5	0	0.87	13.75
	Family Practitioners	1	8	0	1.14	14.33
	Gastroenterologists	b	7	0	0.74	13.86
	Internists	48	7	0	1.03	12.92
	TOTAL	100	6	0	0.95	13.32

[a]Times are reported in minutes.

[b]Less than one-half of one percent.

Source: Actual Medicare allowed charges were obtained from 1985 BMAD claims data. Procedure time and complexity estimates were calculated from the Physicians' Practice Follow-up Survey.

TABLE 4-2 (continued)

PROCEDURE TIME AND COMPLEXITY BY MEDICAL AND SURGICAL SPECIALTIES

		Percent of Claims	Procedure Time[a]	Pre- & Post-Op. Time[a]	Standardized Complexity	Allowed Charge
Swan-Ganz catheterization (CPT-4 93503)						
Medical	Cardiologists	100%	42	0	2.41	$287.33
Surgical	Cardiovascular/Thoracic Surg.	100	22	0	1.36	244.89
Interpretation and report (only) for an EEG--awake, drowsy and asleep (CPT-4 95819)						
Medical	Neurologists	100	14	0	1.90	38.83
Surgical	Neurological Surgeons	100	15	0	3.13	32.77
Biopsy of skin, or subcutaneous tissue and/or mucous membrane (CPT-4 11100)						
Medical	Dermatologists	100	14	24	1.77	39.70
Surgical	Plastic Surgeons	100	25	28	.67	43.05
Excision of benign lesion on trunk, arms, or legs--1.0 to 2.0 cm (CPT-4 11402)						
Medical	Dermatologists	100	29	36	2.07	65.86
Surgical	General Surgeons	91	28	55	.70	75.33
	Plastic Surgeons	9	31	51	.82	83.13
	TOTAL	100	28	54	.71	76.03
Excision of benign lesion on trunk, arms, or legs--3.0 to 4.0 cm (CPT-4 11404)						
Medical	Dermatologists	100	48	51	2.95	99.53
Surgical	General Surgeons	90	37	68	1.28	109.56
	Plastic Surgeons	10	46	61	1.11	133.63
	TOTAL	100	38	67	1.27	109.97

[a]Times are reported in minutes.

Source: Actual Medicare allowed charges were obtained from 1985 BMAD claims data. Procedure time and complexity estimates were calculated from the Physicians' Practice Follow-up Survey.

TABLE 4-2 (continued)

PROCEDURE TIME AND COMPLEXITY BY MEDICAL AND SURGICAL SPECIALTIES

		Percent of Claims	Procedure Time[a]	Pre- & Post-Op. Time[a]	Standardized Complexity	Allowed Charge
Excision of benign lesion on face, ears, eyelids, nose, or lips--0.5 to 1.0 cm (CPT-4 11441)						
Medical	Dermatologists	100%	26	33	2.81	$59.06
Surgical	Plastic Surgeons	100	36	49	1.35	77.95
Excision of benign lesion of face, ears, eyelids, nose, or lips--1.0 to 2.0 cm (CPT-4 11442)						
Medical	Dermatologists	100	35	34	3.23	77.22
Surgical	Plastic Surgeons	100	45	52	1.56	118.15
Destruction of facial lesion by any method including local anesthesia (CPT-4 17000)						
Medical	Dermatologists	100	13	0	1.88	31.15
Surgical	Plastics Surgeons	100	23	0	.79	33.97

[a]Times are reported in minutes.

Source: Actual Medicare allowed charges were obtained from 1985 BMAD claims data. Procedure time and complexity estimates were calculated from the Physicians' Practice Follow-up Survey.

TABLE 4-3

TIME AND COMPLEXITY BY MEDICAL AND SURGICAL SPECIALTIES FOR RADIOLOGICAL PROCEDURES

		Percent of Claims	Procedure Time[a]	Standardized Complexity	Allowed Charge
Interpretation and report (only) for a complete sinus X-ray, with a minimum of 3 views (CPT-4 70220)					
Medical	Radiologists	100%	5	0.85	$18.48
Surgical	Ears, Nose, and Thoat Surg.	100	7	0.62	17.16
Interpretation and report (only) of a complete skull X-ray with a minimum of four views (CPT-4 70260)					
Medical	Neurologists	c	11	1.95	19.95
	Radiologists	100	6	0.98	21.93
	TOTAL	100	6	0.99	21.93
Surgical	Neurological Surgeons	100	7	1.25	21.42
Interpretation and report (only) for a chest X-ray with two views (CPT-4 71020)					
Medical	General Practitioners	1	8	1.00	12.73
	Cardiologists	1	7	1.00	13.72
	Dermatologists[b]	--	--	1.00	--
	Family Practitioners	c	7	1.00	13.34
	Gastroenterologists	c	7	1.00	13.72
	Internists	1	7	1.00	13.78
	Neurologists	c	3	1.00	13.79
	Radiologists	96	5	1.00	14.23
	TOTAL	100	5	1.00	14.20
Surgical	General Surgeons	32	7	1.00	13.25
	Ears, Nose, and Throat Surg.	4	12	1.00	14.51
	Neurological Surgeons	2	7	1.00	13.52
	Obstetricians/Gynecologists	4	8	1.00	13.78
	Ophthalmologists	20	9	1.00	13.01
	Orthopedic Surgeons	10	7	1.00	13.22
	Plastic Surgeons	1	8	1.00	6.62
	Cardiovascular/Thoracic Surg.	8	8	1.00	13.57
	Urologists	19	6	1.00	13.22
	TOTAL	100	7	1.00	13.23

a Times are reported in minutes.

b No dermatologist in our sample reported performing a chest x-ray at least monthly. Consequently, the complexity estimate for internists was used to standardize dermatologists' complexity estimates.

c Less than one-half of one percent.

Source: Actual Medicare allowed charges were obtained from 1985 BMAD claims data. Procedure time and complexity estimates were calculated from the Physicians' Practice Follow-up Survey.

TABLE 4-3 (continued)

TIME AND COMPLEXITY BY MEDICAL AND SURGICAL SPECIALTIES FOR RADIOLOGICAL PROCEDURES

		Percent of Claims	*Procedure Time*[a]	*Standardized Complexity*	*Allowed Charge*
Interpretation and report (only) for a spine X-ray--lumbosacral, anteroposterior and lateral (CPT-4 72100)					
Medical	Neurologists	b	10	1.71	$12.20
	Radiologists	100%	6	0.89	16.21
	TOTAL	100	6	0.90	16.21
Surgical	Neurological Surgeons	7	7	1.06	14.67
	Orthopedic Surgeons	93	8	1.25	17.41
	TOTAL	100	8	1.24	17.22
Interpretation and report (only) for a complete hip X-ray -- unilateral, with a minimum of two views (CPT-4 73510)					
Medical	Radiologists	100	5	0.73	15.55
Surgical	Orthopedic Surgeons	100	6	1.11	16.11
Interpretation and report (only) for an upper GI series (CPT-4 74240)					
Medical	Gastroenterologists	c	16	1.59	33.94
	Radiologists	100	12	1.34	30.37
	TOTAL	100	12	1.34	30.37
Interpretation and report (only) for an abdominal ultrasound (CPT-4 76700)					
Medical	Gastroenterologists	c	10	1.48	43.22
	Radiologists	100	12	1.80	53.16
	TOTAL	100	12	1.80	53.14
Surgical	Obstetrics/Gynecology	100	17	1.48	57.34

[a]Times are reported in minutes.

[c]Less than one-half of one percent.

Source: Actual Medicare allowed charges were obtained from 1985 BMAD claims data. Procedure time and complexity estimates were calculated from the Physicians' Practice Follow-up Survey.

TABLE 4-4

TIME AND COMPLEXITY BY MEDICAL AND SURGICAL SPECIALTIES FOR VISITS

		Procedure Time[a]	*Standardized Complexity*	*Allowed Charge*
Initial comprehensive office visit for a new patient (CPT-4 90020)				
Medical	General Practitioners	39	2.06	$39.74
	Cardiologists	55	2.19	65.06
	Dermatologists	25	2.59	36.20
	Family Practitioners	41	2.13	39.12
	Gastroenterologists	51	2.49	67.70
	Internists	54	2.42	60.66
	Neurologists	60	3.35	70.66
Surgical	General Surgeons	37	1.93	38.06
	Ear, Nose, and Throat Surg.	23	0.83	36.49
	Neurological Surgeons	52	3.05	56.99
	Obstetricians/Gynecologists	34	1.54	41.72
	Orthopedic Surgeons	35	2.16	42.90
	Plastic Surgeons	34	0.91	37.76
	Cardiovascular/Thoracic Surg.	50	1.52	44.95
	Urologists	34	1.32	39.05
Intermediate follow-up office visit for an established patient (CPT-4 90060)				
Medical	General Practitioners	18	1.13	19.73
	Dermatologists	13	1.37	23.94
	Family Practitioners	19	1.12	20.16
	Internists	23	1.31	24.75
Surgical	Plastic Surgeons	15	0.59	23.18
Initial comprehensive hospital visit, with history and examination for a new or established patient (CPT-4 90220)				
Medical	General Practitioners	45	2.19	47.28
	Cardiologists	54	2.33	68.40
	Dermatologists	39	2.80	63.61
	Family Practitioners	50	2.33	42.26
	Gastroenterologists	57	2.53	69.22
	Internists	58	2.57	59.22
	Neurologists	62	3.45	76.06
Intermediate follow-up hospital visit (CPT-4 90260)				
Medical	General Practitioners	18	1.31	21.05
	Family Practitioners	19	1.28	23.27
	Gastroenterologists	19	1.42	26.18
	Internists	21	1.48	24.82

[a] Times are reported in minutes.

Source: Actual Medicare allowed charges were obtained from 1985 BMAD claims data. Procedure time and complexity estimates were calculated from the Physicians' Practice Follow-up Survey.

TABLE 4-4 (continued)

TIME AND COMPLEXITY BY MEDICAL AND SURGICAL SPECIALTIES FOR VISITS

		Procedure Time[a]	Standardized Complexity	Allowed Charge
Discharge hospital visit (on final day of a multiple-day stay) (CPT-4 90292)				
Medical	General Practitioners	25	1.42	$26.46
	Family Practitioners	26	1.45	28.22
	Internists	27	1.50	31.61
Initial comprehensive consultation (CPT-4 90620)				
Medical	General Practitioners	40	2.11	70.22
	Dermatologists	27	3.00	67.19
	Family Practitioners	45	2.13	67.48
	Gastroenterologists	58	2.64	85.87
	Internists	59	2.70	84.65
	Neurologists	58	3.42	88.67
Surgical	Plastic Surgeons	34	0.96	60.91

[a]Times are reported in minutes.

Source: Actual Medicare allowed charges were obtained from 1985 BMAD claims data. Procedure time and complexity estimates were calculated from the Physicians' Practice Follow-up Survey.

were so dominant in the provision of selected services, that the weighted times, complexities, and charges reflect radiology averages almost exclusively. Neurologists, for example, account for less than one-half of one percent of all claims for skull x-ray. Similarly, radiologists represent 96 percent of all claims for chest x-rays within the medical specialty group.

As indicated above, visits were not combined across specialties because it was felt that visits are heterogeneous products. Table 4-4 shows the procedure time, standardized complexity and allowed charge for each type of visit included in the survey. Physician reports of the average time for an initial comprehensive office visit ranged from 23 minutes for ENT specialists to 55 minutes for cardiologists. Standardized complexity ranged even more widely, from less than one for ENT specialists and plastic surgeons to over three for OBGYNs and neurologists.

Once the common procedures were combined across medical and surgical specialties, a few modifications were made to the list of procedures. Upon inspection of the reported times and complexities for the intra-aortic balloon catheter (specified in the survey as CPT-4 93535), we were concerned that physicians may have been confused about which procedure we were referring to. CPT-4 now distinguishes between percutaneous insertion of balloon catheter (93536) and balloon counterpusation (33970). This procedure was omitted from our analysis.

In addition, several radiology procedures had to be dropped from the regression analysis due to respondent confusion about whether they were supposed to report times for interpretation and report only or for performing the entire procedure. The omitted procedures are: bone imaging of whole body (CPT-4 78306), magnetic resonance imaging (MRI) of head (70550), head cat scan without contrast (70450) and with and without contrast (70470), abdomen cat scan with contrast (74160), and with and without contrast (74170), barium enema (74270), intravenous urography (74400), and daily simple megavoltage treatment (77400). Ophthalmic biometry (76516, 76517) was included in the surgical equation as reported by ophthalmologists, but was excluded from the medical equation for radiologists. It appears from BMAD claims data that virtually all ophthalmologists perform the entire procedure, while virtually no radiologists perform the procedure in its entirety. Thus, we felt confident that ophthalmologists were reporting on the correct procedure, while radiologists probably were not.

4.4 Regression Methodology

4.4.1 Scaling Method for Time and Complexity

Once estimates of time and complexity are derived from our survey data, they need to be weighted in some fashion to produce a predicted, or justified,

payment amount. Time is reported in minutes and the complexity scale ranges from 1 to 100. If one simply adds the two (unweighted or weighted) and then divides through by a numeraire procedure, the resulting scale is sensitive to the original units.* Dividing through, first, by mean time and complexity separately avoids the units problem, but no _a priori_ theory suggests how to combine the two scales. Should they be weighted equally? Should they be added or multiplied? A regression equation based on allowed charges has the advantage of implicitly weighting time and complexity in terms of the physicians' own fees rather than a purely subjective judgment of how important each dimension is separately.

One possibility, used in this report, is to regress Medicare allowed charges for selected procedures on reported average time and complexity. The following multiplicative model is a particularly appropriate specification:

$$f_i = A*T_i^{\alpha}*C_i^{\beta} \tag{1}$$

where

f_i = the average national allowed charges for the i-th procedure;

T_i = average reported procedure time;

C_i = average reported complexity; and

A, α, and β = parameters to be estimated.

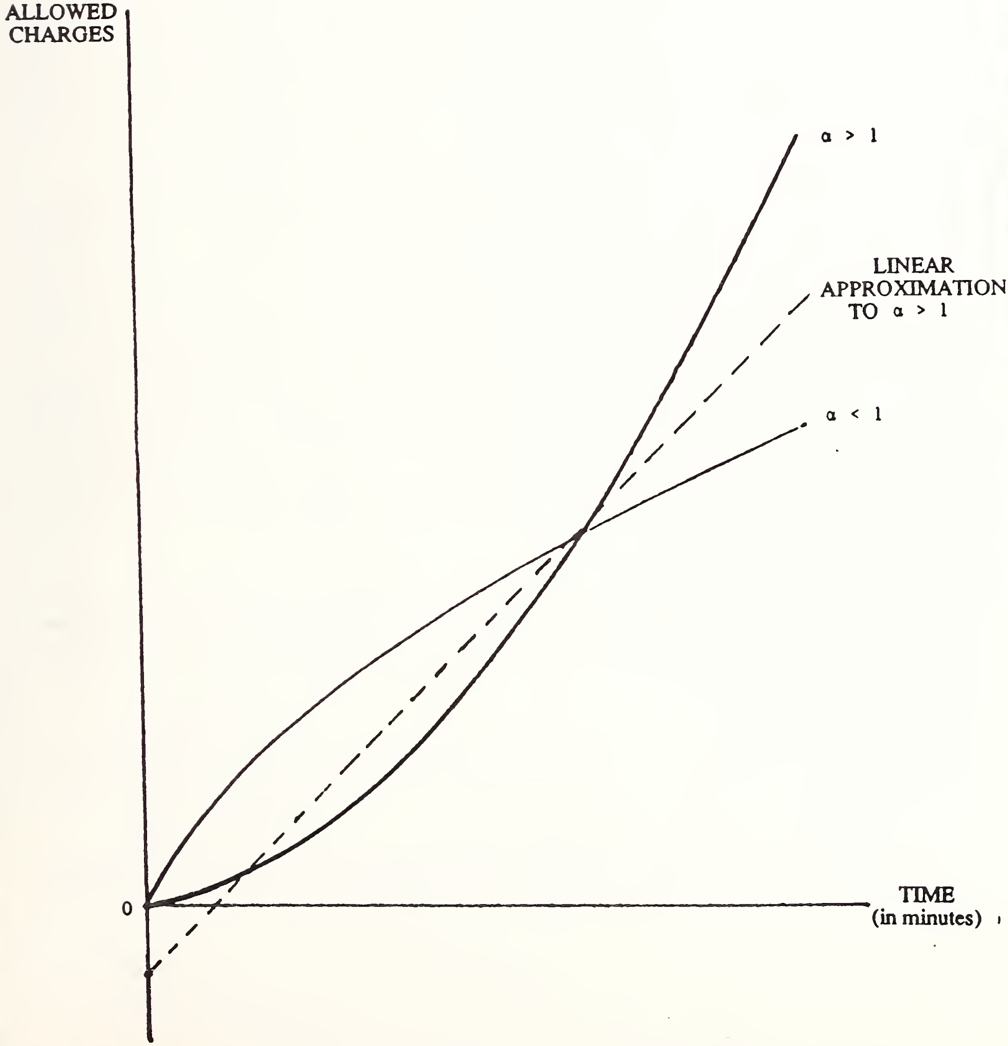
The estimated α and β parameters can be interpreted as fee elasticities with respect to time and complexity, respectively. In other words, α (or β) can be interpreted as the percent increase in observed fees when time of procedure (or complexity) increases one percent, holding complexity (or time) of procedure constant. It should be noted that such a weighting approach is predicated on the assumption that fees generally reflect procedure time and complexity as a whole, if not for certain "overpriced" procedures.

A log-linear multiplicative model based on fees has several useful properties for scaling time and complexity. _First_, when time and complexity are both zero, no fee is assumed to be charged.

*In other words, whether time is measured in hours or minutes will drastically change (by a factor of 60) its importance relative to complexity in computing a relative value scale. In determining the underlying contribution to "effort," we cannot categorically assert that one minute (or one hour) is equivalent to, say, one unit of complexity measured on an arbitrary scale of 1 to 100.

FIGURE 4-1

NON-LINEAR RELATIONSHIP BETWEEN TIME AND CHARGES



Second, the functional form allows for the possibility that fees rise non-linearly with either time or complexity, as indicated in Figure 4-1. If, ceteris paribus, fees rise 50 percent for procedures taking twice as long, $\alpha = .5 < 1$, then the marginal change in fees falls in percentage (and absolute) terms as length of time increases. Conversely, if α is greater than 1.0, fees rise exponentially with time (see Figure 4-1).* A similar graph could be produced with complexity on the horizontal axis and time held constant. Allowing the fee elasticity with respect to complexity to exceed 1.0 is especially desirable if the complexity scale is bounded 1 to 100 while fees are, in principal, unconstrained. Thus, instead of applying a linear constraint that scales every unit increase in complexity the same in terms of fees, the multiplicative model, by allowing for $\beta > 1$, allows for the possibility that higher complexity procedures raise fees more per complexity unit than do lower complexity ones.

Third, all predicted fees lie in the positive range. This can be a problem with a strictly linear model that predicts negative prices for procedures of very low time and complexity when the relationship is exponential. This can be illustrated in Figure 4-1. If fees actually rose exponentially with time (or complexity), then $\alpha > 1$ and the fee-time curve would rise rapidly. If a linear form was fitted to such data, as shown by the dotted line, the line would become negative for very short procedure times.

A fourth advantage to the multiplicative form is that time and complexity effects are treated interactively in that the rate of change of fees with respect to either time or complexity is higher at higher levels of the other variable.** This can be seen in Figure 4-2 where the fee-time curve is (slightly) concave (i.e., $\alpha < 1$). The multiplicative complexity adjustment rotates the curve upwards around the origin, raising the absolute fee increase associated with a given procedure time. The two time and

---

*Exponential growth, of course, may only apply in the relevant range of time, say, from 0 to 8 hours. Beyond that, fees may rise more slowly.

**Differentiating eq. (1) with respect to time, for example, gives,

$$\frac{P}{T} = \alpha A T^{\alpha-1} C^{\beta} > 0.$$

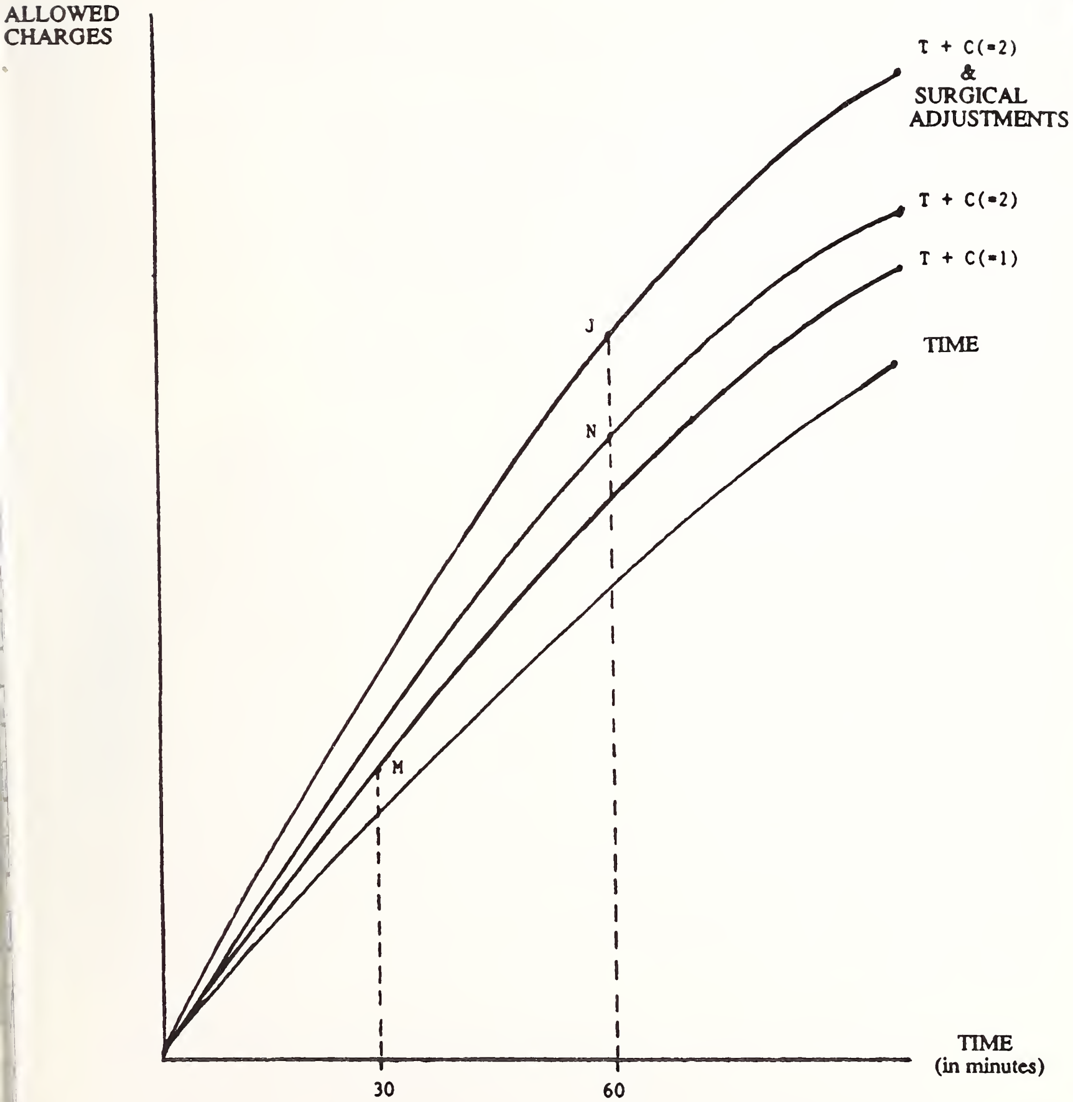
Differentiating again with respect to complexity,

$$\frac{P}{T\ C} = \beta \alpha A T^{\alpha-1} C^{\beta-1} > 0$$

which is also positive, implying rising fees per minute with higher complexity.

FIGURE 4-2

RELATION OF ALLOWED CHARGES TO TIME AND COMPLEXITY



NOTE: T = Time; C = Complexity

complexity curves shown in Figure 4-2 for C=1 and C=2 are two of many depending on the actual complexity value (and the size of β). The larger the estimated β, the steeper will be each fee per minute gradient and the implicit value of complexity.

Fifth, the combined effects of time and complexity on fees will depend upon the sum of the two elasticities (see Chiang, 1974, Section 12.5). If

$(\alpha + \beta) < 1$: Then the equation is less than homogeneous of the first degree such that a doubling of time and complexity will not even produce a doubling in fees. For instance, a procedure taking 30 minutes with a relative complexity of 1 would imply a fee = M in Figure 4-2. Another procedure taking 60 minutes with C=2 would cost N. In this case, $(N/M) < 2$.

$(\alpha + \beta) = 1$: Then the equation is exactly linearly homogeneous so that a doubling of time and complexity results in exactly doubled fees, or (N/M) in Figure 4-2 equals 2.

$(\alpha + \beta) > 1$: Then the equation is greater than linearly homogeneous so that a doubling of time and complexity results in more than a doubling in fees, or (N/M) in Figure 4-2 is more than 2.

Note that assuming $\alpha = \beta = 1$, as has been done in some earlier studies of time and complexity, implies that fees can be explained simply as the product of time and complexity. Under this assumption, the equation is homogeneous of degree two, $(\alpha + \beta) = 2$, and fees (or assumed effort) quadruple when time and complexity double. If fees did not rise as fast as implicitly hypothesized by the assumption that $\alpha = \beta = 1$, the naive use of the model would tend to "over predict" fees for longer, more complex procedures, thereby possibly understating the number and kinds of overpriced procedures. Of course, if $(\alpha + \beta) > 2$, a doubling of time and complexity leads to more than a quadrupling of fees and a model constraining $\alpha = \beta = 1$ would produce too many overpriced procedures in the high time and/or complexity range.* Hence, a multiplicative model with unconstrained time and complexity elasticities has the capability of explaining very large fees with relatively modest increases in the two variables.

Even with such flexibility, however, the model may be incapable of adequately explaining a given class of expensive procedures such as surgery. If no adjustment is made for surgery in the model, one implicitly assumes that all procedures fall on the same time and complexity curve or, at least one assumes they should do so, otherwise the whole class of procedures is overpriced.

*On the other hand, if one had independent data (or theory) showing that "effort" truly increased as the simple product of time and complexity, then the fact that $(\alpha + \beta) > 2$ from estimated fee equations would be irrelevant and many more procedures could be considered overpriced. The methodology using fees to scale time and complexity is conservative in the sense that it allows for more than double homogeneity, which would "justify" in a relative fee sense very high fees for some, if not all, long, complex, procedures.

Two important modifications were made to the predicting equation. First, the sum of pre- and post-operative times was added to the model. In the surgical equation, pre/post time was treated as a separate variable with its own exponent, while in the medical equation it was added to procedure time since only a few procedures involved pre/post care.** If pre- and post-operative times are ignored, their effects will produce an upward bias in the true procedure time and complexity coefficients. By separating pre/post time from procedure time, the multivariate regression has the flexibility of assigning a lower marginal value to the former if physicians or patients view pre/post time as being less complex. Thus, although it is reasonable to expect physician fees to rise with more pre/post time, they should do so at a slower rate than the more "valuable," more "complex" procedure time.

Another important modification was made by adding a multiplicative dummy variable for surgery to test for the possibility of two distinct curves, i.e.

$$f_i = A'*S^{\gamma}*T_i^{\theta}*C_i^{\psi} \quad . \tag{2}$$

where

S = 2 for an invasive diagnostic or therapeutic surgical procedure; otherwise S = 1.*

If the θ surgical adjustment were positive and statistically significant, one could conclude that surgical procedures follow a similar, albeit higher, time-complexity curve with respect to fees, and that the number and types of overpriced procedures will depend on whether surgical procedures are evaluated along this higher time-complexity curve.

This can be shown in terms of Figure 4-2 where a positive surgical adjustment further rotates upward the family of time and complexity curves. Only one is drawn for C=2 for simplicity. Thus, a 60-minute medical procedure with a complexity of 2 would be paid N while a similar surgical procedure would be paid J.

Identifying overpriced surgical procedures with a general adjustment for surgery would have the following specific interpretation, e.g.,

> Surgical procedure CPT-4-XXXXX has an actual Medicare allowed charge, say, 25 percent above that predicted by time and complexity, even allowing for the fact that surgical procedures have higher fees per reported level of time and complexity than do medical procedures.

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*In logarithmic form, the dummy variable takes on the values (1,2) since it is not possible to take the log of zero.

**In the medical equation, pre/post times were added to procedure time for the two pacemaker procedures, as these were the only procedures to actually include pre/post times. While pre/post times had been collected for minor skin procedures performed by dermatologists and plastic surgeons, by an oversight comparable times were not asked for other minor invoice procedures like endoscopies. Therefore, we decided to include pre/post times only for operating room procedures.

Such an adjustment is expected to reduce the number of overpriced surgical procedures, producing a much more conservative list that essentially accepts the notion that surgical procedures on average are correctly priced relative to each other, if not to medical procedures more generally. If one prefers not to accept this notion, an evaluation of equations with and without the θ adjustment gives the average percentage by which surgical procedures may be overpaid as a group.

One final point on including a surgical dummy. By explicitly adjusting for medical versus surgical procedure, it is quite likely that the time and complexity elasticities could change considerably. If both are higher in general for surgical procedures, then ρ and χ will be lower than α and β, respectively. As a result, it would be possible for some very long surgical procedures to have a lower predicted fee even after allowing for higher surgical fees in general. This, in fact, does happen for a few procedures such as heart bypasses in the empirical work that follows.

In addition to the possibility that medical and surgical procedures exhibit different time-and-complexity fee gradients, it is also conceivable that the two gradients vary systematically between medical and surgical specialists. The curves shown in Figure 4-2 can be considered averages of the two specialties. In actuality, surgical specialists may be on a higher gradient than medical specialists for their surgical procedures, their medical procedures, or both. Thus, a still more conservative approach than just using a medical versus surgical gradient would use four gradients rather than two, evaluating overpriced procedures within procedure type within specialty.

The argument for making a medical-surgical specialty distinction stems from the difficulty physicians may have in evaluating relative complexity -- particularly on a closed scale of 1 to 100. If surgeons systematically overrate the base procedures (i.e., chest x-ray), then their most complex surgeries will not reflect the true complexity range. A compression of complexity values results in a failure of a pooled medical-surgical specialty regression to accurately reflect the value of their own complex procedures. This leads to under-prediction of fees for longer, more complex surgeries (which surgeons are more likely to do), and to too many of them being identified as overpriced. By estimating surgeons' procedures separately, we permit the complexity impact on fees-per-minute to rise faster with reported complexity than it would if constrained to the relationship among medical specialists. The interpretation of an overpriced surgical procedure is as stated above, except that it is now more narrowly based on one's own specialty peers.

4.4.2 Estimation Method

Eqs. (1) and (2) are estimated for a sample of 139 procedures by first taking logs, then applying ordinary least squares regression to the transformed equations:

$$\ln P_i = \ln A + \alpha \ln T_i + \beta \ln C + \eta_i \qquad (3)$$

$$\ln P_i = \ln A' + \theta \ln S_i + \rho \ln T_i + \chi \ln C_i + \psi_i \qquad (4)$$

where

η_i and ψ_i = additive error terms whose expected value is zero.

The equations are estimated in several steps. Eq. (3) is estimated first. Then a dummy surgical variable (S = 1 or 2) is stepped in in a second step. Differences between the time and complexity coefficients in (3) versus (4) depend on their correlation with surgery and how important the latter is in explaining charge variation. If the surgery coefficient is large and if either time or complexity are highly correlated with surgery, the α or β coefficients will fall considerably in eq. (4).

The two equations are estimated for medical and surgical specialists separately on the grounds that their relative fee structures based on time and complexity might be incomparable. If the complexity coefficients, in particular, are different, this could be taken as evidence of the error introduced in the scaling for surgeons. In addition, for purposes of comparison, we present the results from a pooled regression of medical and surgical specialists combined.

Once the equations have been estimated, predicted amounts are produced based on actual mean time and complexity for each procedure. This requires taking the anti-log of the predicted value. As predicted values from a logged equation will under-predict payment amounts depending on the explanatory power of the equation, all values were adjusted upwards using a formula developed by the staff at the RAND Corporation. Finally, predicted amounts are compared to actual allowed charges to indicate which procedures appear to be over- or underpaid.

A 95 percent confidence interval was constructed around the adjusted predicted amount that indicates the potential error in the predicted value (Kmenta, 1971). Actual fees falling within this band may not involve over- or underpayments if the true predicted value were at the low or high end of the interval.

4.5 Regression Results

Table 4-5 displays the results of a double-log OLS regression of 139 Medicare allowed charges on reported procedure time and complexity. Cols. (1) and (4) include procedure time and standardized complexity for medical and surgical specialists respectively, and correspond to eq. (3) in the text. In cols. (2) and (5), pre/post time is entered and finally in cols. (3) and (6) the surgical procedure dummy is included (as in eq. (4) in the text). For purposes of comparison, the parameters of a pooled regression (medical and surgical specialists combined) are shown in col. 7.

The coefficients can be interpreted as the percentage effect on fees of a 1 percent increase in either time or complexity. For example, a 1 percent increase in procedure time results in a .24 percent increase in fees according to column 1. In columns 2 and 3, no pre/post coefficients are reported in the medical specialists' equations because only a few procedures (i.e., ventricular and AV sequential pacemakers) involved such times; their pre/post times were added to procedure time. Explanatory power ranges from 60 to 91 percent, and all included variables are highly significant (with the exception of the time coefficient in column 1), both statistically and in terms of their marginal effect on payments. <u>This confirms the hypothesis that physician fees in general are strongly related to time and complexity, particularly for surgeons</u>.

The time elasticity of 1.08 in the surgical specialist equation (column 4) implies returns to scale to physician input in that a doubling of time results in a 108 percent increase in fees for procedures of equal complexity. The complexity elasticity of .90 implies a less than proportionate increase in fees per physician minute with rising complexity. This is slightly less than the 1.0 implicitly assumed in the naive time-and-complexity model where $\alpha=\beta=1$. Nevertheless, the sum of the two elasticities is nearly 2.0 implying close to a quadrupling in fees with a doubling of time and complexity, conforming surprisingly well to the naive model which assumes $(\alpha+\beta) = 2$.

When pre/post times are added, the coefficient on procedure time in the medical specialist equation rises and becomes significant and the complexity coefficient drops substantially. In the surgical specialist equation, the inclusion of a separate pre/post time variable results in a reduction in both procedure time and complexity coefficients, suggesting that part of the original time-complexity-price relationship was explained by the positive correlation of time and complexity with pre/post time and the fact that procedures requiring more pre/post time are paid more as a whole.

TABLE 4-5

MEDICARE PRICE REGRESSION EQUATIONS: SEPARATE VS. POOLED REGRESSIONS

	Medical Specialists			Surgical Specialists			Pooled Medical and Surgical
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Logarithm of procedure time	.24 (.22)	.51* (.16)	.55* (.13)	1.08* (.15)	.66* (.14)	.59* (.11)	.55* (.24)
Logarithm of pre/post time	--	--a	--a	--	.29* (.04)	.18* (.04)	.21* (.03)
Logarithm of complexity	1.43* (.38)	.96* (.32)	.55# (.26)	.90* (.17)	.47* (.15)	.54* (.12)	.49* (.11)
Logarithm of surgery dummy (= 1 or 2)	--	--	1.34* (.21)	--	--	1.47* (.19)	1.50* (.15)
Intercept	2.36* (.50)	1.75* (.38)	1.64* (.30)	.57 (.47)	1.86* (.43)	1.64* (.33)	1.72* (.24)
R^2 adjusted	.60	.65	.79	.79	.86	.91	.91
F	51.4*	62.4*	82.7*	169.2*	185.2*	246.0*	361.9*

*$P \leq .01$.

#$P \leq .05$.

Standard errors in parentheses.

[a] Procedure time includes pre/post time for surgical procedures performed by medical specialists.

Note: Coefficients for time and complexity can be interpreted as the percent increase in charges associated with a 1 percent increase in time or complexity. Coefficients of the surgical dummy and the intercept can be evaluated as exponents of 2 or the base of the natural log, e, respectively. In equation (3), for example, a surgical procedure is $2^{1.34} = 2.5$ times more expensive than a medical service. The intercept coefficient in equation (3) implies that a medical service of complexity = 1 involving 1 minute of procedure and pre/post time would cost $e^{1.64}$ = \$5.16.

Without controlling for surgery but including pre/post time (cols. 2 and 5), procedure-specific time and complexity coefficients individually are less than 1.0 but sum to more than 1.0, i.e., 1.47 for medical specialists versus 1.13 for surgeons. Thus, a doubling of procedure time and complexity results in somewhat more than a doubling of fees, but certainly less than the quadrupling of fees imposed by a simple multiplicative model.

When the surgery dummy is included, time and complexity effects rise or fall depending on specialty group (see cols. 3 and 6). The complexity effect is nearly halved for medical specialists and is raised slightly among surgeons. This implies that medical specialists tend to view surgery as relatively more complex than do surgeons. Procedure time and complexity coefficients become almost identical in the medical and surgical specialist equations when surgery is controlled for (ranging between .54 and .59). This produces decidedly concave fee growth curves with respect to procedure time, (Figure 4-3). Hence, a doubling of procedure time, holding complexity and pre/post time constant, results in a 40-50 percent increase in fees, not 100 percent. A doubling of both time and complexity, however, produces slightly more than a doubling of fees. This is far less than the quadrupling of fees that would occur in a simple multiplicative model.

Figure 4-4 shows the effects of higher complexity on the non-surgical services of surgeons. A one hour service rated at triple the complexity of another service implies 81 percent higher fees, holding pre/post time constant. The figure for medical specialists is essentially identical.

The surgery dummy also has a large effect on predicted amounts, as shown in Figure 4-5. Holding procedure time and complexity constant, and assuming minimal pre/post time, surgical procedures are 2.8 times more expensive than medical procedures. (This result is derived by raising the surgery dummy = 2 to the 1.47 power and setting time and complexity to an arbitrary value in col. 4 in Table 4-5). Few medical services take longer than 60 minutes while most major surgical procedures exceed one hour. Hence, most medical services fall along the left-hand portion of the medical service gradient while most major surgeries fall along the surgical procedure gradient beyond 60 minutes. Nevertheless, the fact that the surgical gradient is nearly triple that for medical services implies that higher surgical fees cannot be explained by greater reported time and complexity alone.

For every minute in the operating room, surgeons report spending roughly two minutes in pre and post-operative care. Adjusting for pre/post time separately in the surgeon's equation results in a statistically significant coefficient ($p < .01$) approximately one-third the size of the coefficient for procedure time (col. 6, Table 4-5). The effect is to rotate the surgical fee gradient upwards (Figure 4-5). This produces a widening gap in fees between medical and surgical procedures, as the latter involve three minutes for every

one minute of a medical service. For example, a 60 minute, complexity 3, medical service performed by a surgeon would cost \$113 versus \$312 for a surgical procedure with no pre/post time. Adding 120 minutes of pre/post time raises the total fee to \$740 or \$247 per hour. Note that this hourly rate is somewhat less than the \$312 received with no pre/post time. Evaluating the surgeon's pre/post time at a lower marginal rate has a decided effect on whether certain procedures are considered outliers or not, as shown below.

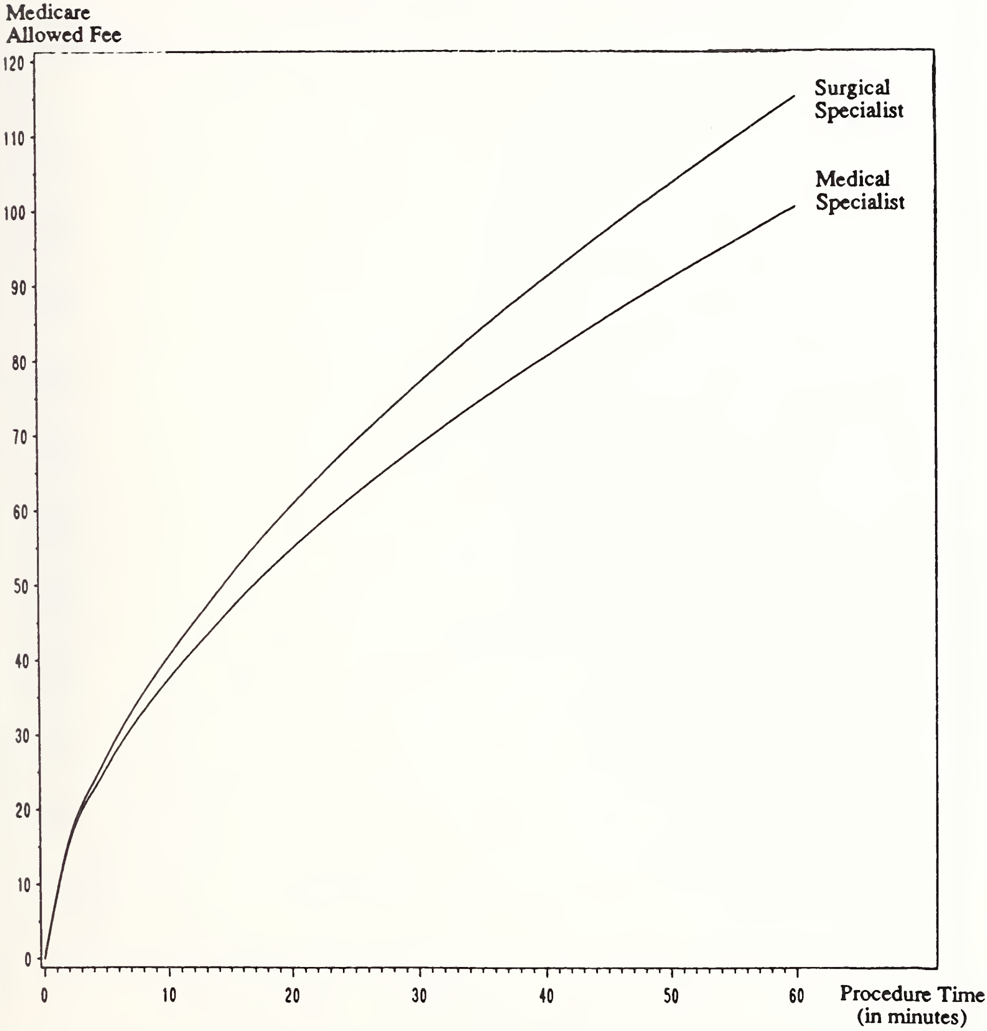
Controlling for surgery does not guarantee that every surgical procedure will have a higher predicted fee because of offsetting reductions in the value of time and complexity generally. Without a surgical adjustment, both procedure and pre/post time have a larger positive effect on fees (compare cols. 5 and 6 in Table 4-5). Thus, surgeries longer than about an hour exhibit a higher predicted amount <u>without</u> an explicit surgical adjustment because the surgeon's time is valued more (Figure 4-6). This occurs because a higher value is placed on procedure and pre/post time in lieu of a separate surgical allowance. Once an across-the-board (2.8) multiplicative adjustment is made, the value of time is substantially reduced and longer surgeries are evaluated more conservatively. This explains why several of the predicted surgical amounts actually fall in Tables 5-1 and 5-2 below after adjusting for surgery. Because the surgical adjustment substantially improves the explanatory power of the model, the predicted amounts based on the surgical adjustment are preferred statistically, i.e., have a narrower confidence interval. However, as a case can be made for not basing fee outliers controlling for surgery, outliers using both models are shown below.

We now turn to a discussion of the final equation, on Table 4-5, the pooled regression of medical and surgical specialists combined. This specification includes procedure time, standardized complexity, pre/post time, and the surgical adjustment. This model is comparable to cols. 3 and 6 for medical and surgical specialists respectively. The explanatory power of this equation is .91, identical to the surgeons' equation. The coefficients on time and complexity are remarkably similar in the pooled and surgical regressions, and only slightly different from the medical regressions (primarily in the marginal fee increase for time spent providing pre- and post-operative care).

Several modifications have been made to the basic specifications shown in Table 4-5. <u>First</u>, a "time-only" regression was run, omitting the complexity measure for each procedure. Compared to the regressions with both time and complexity, the time coefficient alone is three to four times higher, suggesting that time and complexity are highly correlated. Thus, when a separate complexity measure is omitted, the time variable also captures complexity. For example, in the medical specialists' equation shown in col. 1

FIGURE 4-3

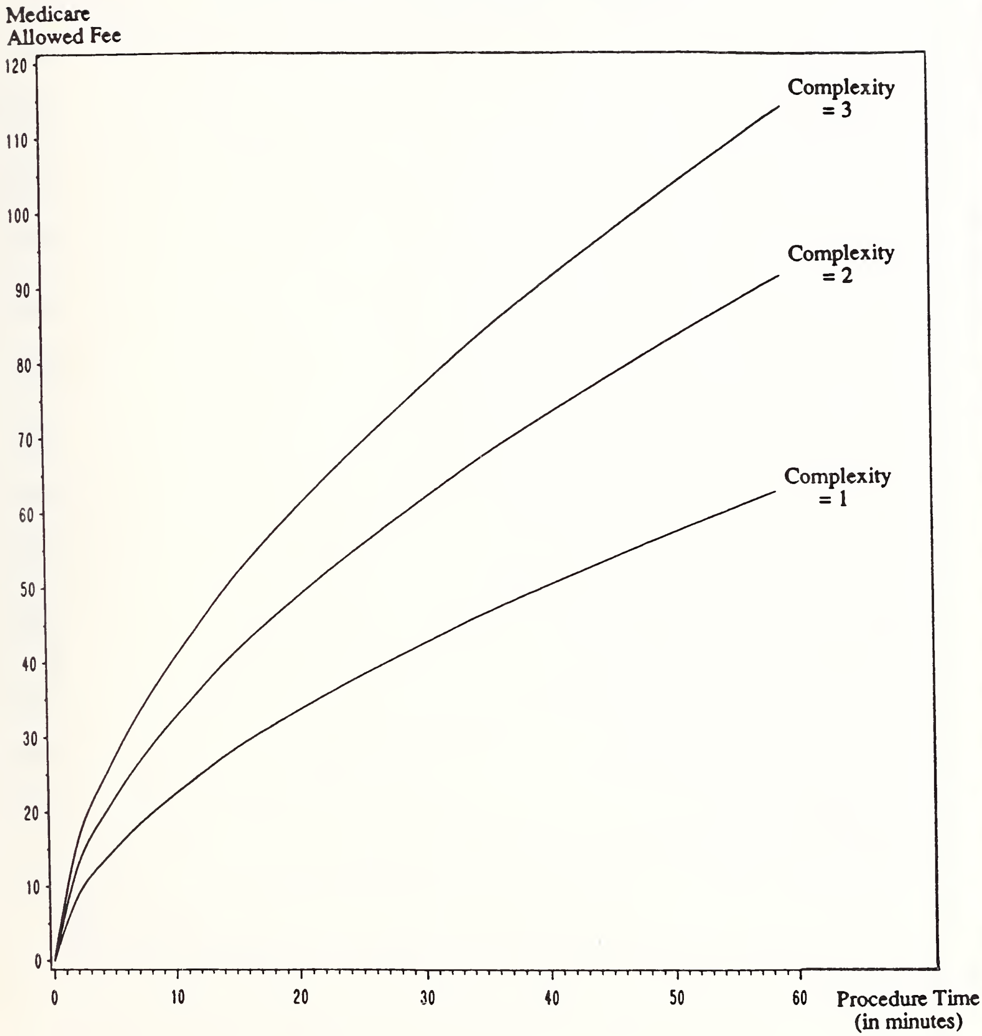
RELATIONSHIP OF PROCEDURE TIME AND 1985 MEDICARE ALLOWED CHARGES FOR A MEDICAL SERVICE OF COMPLEXITY 3.0 PERFORMED BY MEDICAL OR SURGICAL SPECIALISTS*



*Curves based on predicted values derived from regression models shown in columns (2) and (4) in Table 3, by setting complexity = 3, pre/post time = 1 minute, and the surgery dummy = 1, then letting procedure time vary from 0 to 60 minutes.

FIGURE 4-4

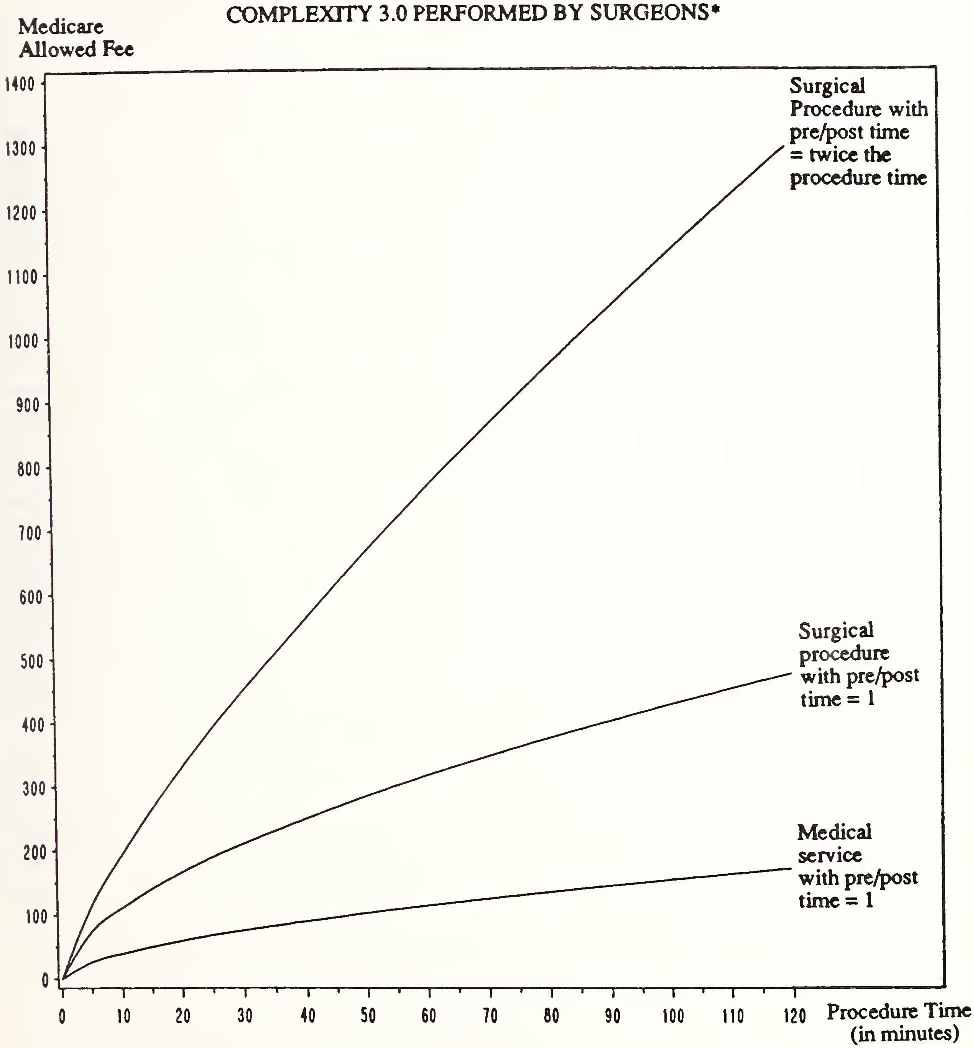
RELATIONSHIP OF PROCEDURE TIME AND COMPLEXITY AND PREDICTED 1985 MEDICARE ALLOWED CHARGES FOR A MEDICAL SERVICE PERFORMED BY SURGEONS*



*Curves based on predicted values derived from regression model number (4) in Table 3, by setting pre/post time = 1 minute and the surgery dummy = 1, and letting procedure time vary from 0 to 60 minutes and complexity from 1 to 3.

FIGURE 4-5

RELATIONSHIP OF PROCEDURE AND PRE/POST TIME
AND PREDICTED 1985 MEDICARE ALLOWED CHARGES FOR A
MEDICAL AND A SURGICAL PROCEDURE OF
COMPLEXITY 3.0 PERFORMED BY SURGEONS*



*Bottom two curves based on predicted values derived from regression model number (4) in Table 3, by setting complexity = 3.0, pre/post time = 1 minute, the surgical dummy = 1 or 2, and letting procedure time vary from 0 to 120 minutes. The top curve is derived in a similar manner except that pre/post time is assumed to be equal to twice the procedure time.

of Table 4-6, the time coefficient equals .96 compared to only .24 in the equation with both time and complexity. In the surgeons' equation, the time elasticity is 1.69, indicating that a doubling of time would result in a 169 percent increase in fees. However, the time coefficient falls to 1.08 (implying roughly a doubling of fees with a doubling of time) when complexity is introduced into the model (see Table 4-5, col. 4).

Second, an alternative surgical adjustment was made that distinguishes between major operative procedures and minor diagnostic surgery. This modification recognizes that not all surgical procedures are the same. As used by Medicare, "surgery" includes a wide range of services, including diagnostic procedures like endoscopies and cardiac catheterizations, relative minor therapeutic procedures, such as excisions of benign lesions, and of course, major operating room procedures like prostatectomies and CABGs.

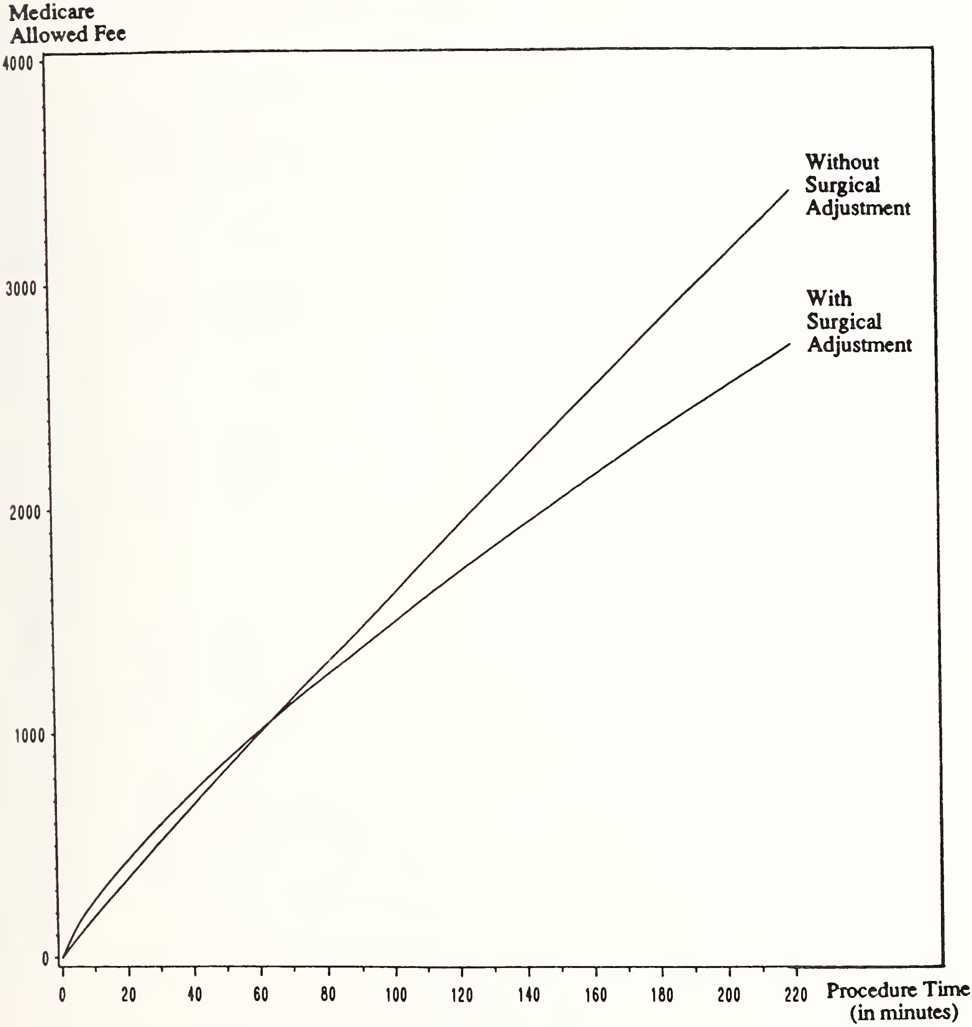
Columns 3 and 4 of Table 4-6 present the regression results based on the dual surgical adjustment. These results can be compared to those in Table 4-5, cols. 3 and 6. The effect of the dual surgical adjustment is substantial. First, the time coefficients are reduced, especially for medical specialists. Whereas with a single surgical dummy variable the time elasticity implied a 5.5 percent increase in fees per 10 percent increase in time, now only a 2.5 percent increase in fees is implied. With the dual surgical adjustment, the major operating room procedures would receive a major fee increase, holding time and complexity constant, relative to the diagnostic surgical procedures. In the medical equation, this translates into huge fee differentials for the two pacemaker procedures versus the endoscopic procedures. This effect will be illustrated in chapter 5. The differential is not quite as large in the surgical equation but nevertheless, major OR procedures are rewarded more than diagnostic procedures -- the differential is only two-to-one, rather than nearly three-to-one in the medical equation.

The third modification involved segmenting the sample based on type of service (surgery versus other) rather than by the specialty of the physician performing the service. Previously, the sample was segmented on the grounds that their relative fee structures based on time and complexity might be incomparable, particularly if the two groups used implicitly different scales to rank complexity. It is possible, however, that the different types of services are so heterogeneous that separate regressions should be estimated for surgery, radiology, visits, etc. We do not have sufficient observations to estimate equations separately for each type of service, but we did estimate a regression for all surgical procedures and another for all other services.

The effect of this third modification is shown in cols. 5 and 6 of Table 4-6. Not surprisingly, given the heterogeneity of service mix that remains in the "medical services" equation, the explanatory power of the "surgical procedures" equation is substantially greater (R-square equal to .86 versus

FIGURE 4-6

RELATIONSHIP OF PROCEDURE TIME AND PREDICTED 1985 MEDICARE ALLOWED CHARGES WITH AND WITHOUT A SEPARATE SURGICAL ADJUSTMENT OF COMPLEXITY OF 5.0 PERFORMED BY SURGEONS*



*Curves based on predicted values derived from regression models in columns (3) and (4) in Table 3, assuming complexity = 5.0, pre/post time = twice the procedure time, and letting procedure time vary from 0 to 220 minutes.

TABLE 4-6

MEDICARE PRICE REGRESSION EQUATIONS: ALTERNATIVE SPECIFICATIONS

	Time Only		Dual Surgical Adjustment		Type of Service	
	Medical Specialists (1)	Surgical Specialists (2)	Medical Specialists (3)	Surgical Specialists (4)	Medical Services (5)	Surgical Procedures (6)
Logarithm of procedure time	.96* (.11)	1.69* (.11)	.25 (.16)	.53 (.10)	.41* (.08)	.96* (.16)
Logarithm of pre/post time	--	--	--a	.08# (.04)	--a	.12* (.04)
Logarithm of complexity	--	--	1.00* (.29)	.46* (.11)	.43* (.13)	.49* (.17)
Logarithm of "major OR" surgical dummy (=1 or 2)	--	--	3.04* (.60)	2.48* (.34)	--	--
Logarithm of diagnostic surgical dummy (=1 or 2)	--	--	1.13* (.21)	1.27* (.19)	--	--
Intercept	.96* (.37)	-.99# (.42)	2.33* (.37)	1.85* (.32)	2.18* (.23)	1.39* (.49)
R^2 adjusted	.52	.72	.81	.92	.61	.86
F	73.8*	237.0*	72.1*	225.4*	56.6*	132.7*

*P $\leq$ .01.

#P $\leq$ .05.

Standard errors in parentheses.

[a]Procedure time includes pre/post time for surgical procedures performed by medical specialists.

Note: Coefficients for time and complexity can be interpreted as the percent increase in charges associated with a 1 percent increase in time or complexity. Coefficients of the surgical dummy and the intercept can be evaluated as exponents of 2 or the base of the natural log, e, respectively. In equation (3), for example, a surgical procedure is $2^{1.34} = 2.5$ times more expensive than a medical service. The intercept coefficient in equation (3) implies that a medical service of complexity = 1 involving 1 minute of procedure and pre/post time would cost $e^{1.64}$ = \$5.16.

5.0 PREDICTED MEDICARE PAYMENT AMOUNTS UNDER A REGRESSION-BASED METHODOLOGY

This chapter presents predicted payment amounts for selected medical and surgical procedures based on the regression equations discussed in chapter 4. First, we show the results from the basic regression including procedure time and complexity. Second, we add time spent providing pre- and postoperative care. Third, we include a surgical adjustment distinguishing surgical from non-surgical procedures. Fourth, we compare results from separate medical-surgical regressions to those obtained under a pooled regression. Fifth, we examine the results from a procedure-time-only regression. Sixth, we use an alternate surgical adjustment that distinguishes major operating room procedures from minor diagnostic surgical procedures. Seventh, we segment the sample according to type of service (medical versus surgical) rather than specialty.

In most of these analyses, the regressions have been run separately for medical and surgical specialists based on the assumption that the two specialty groups used different implicit scales to rank procedure complexity. The medical specialty group included internists, general and family practitioners, dermatologists, cardiologists, neurologists, gastroenterologists, and radiologists. The surgical specialty group included general surgeons, otolaryngologists, neurosurgeons, OB-GYNs, orthopedic surgeons, plastic surgeons, urologists, ophthalmologists, and cardiovascular/thoracic surgeons.

The tables presented in this chapter have been limited to 20 medical and 20 surgical procedures due to space considerations. These procedures were chosen to reflect a mix of specialties, and to include both surgery (major and minor) and the so-called cognitive services. Appendix B documents the regression results for each of the specifications and presents predicted amounts for all procedures included in the study. Each exhibit is sorted according to CPT-4 procedure code and contains the actual Medicare allowed charge, the predicted amount, the percent change from the current charge, and the upper and lower bounds of the 95 percent confidence interval. In addition, the raw data for the separate medical-surgical regressions are displayed in Exhibits B-1 and B-2. For each procedure, the tables show the Medicare allowed charge, procedure time, standardized complexity, pre/post time, and the value on the surgical dummy variable.

5.1 Predicted Medicare Payments for Medical Specialists

Table 5-1 shows the predicted Medicare payment amounts that correspond to the regression equations in Table 4-5. Column 1 displays the actual allowed charge for the selected procedures, while the predicted amounts for

TABLE 5-1

ACTUAL AND PREDICTED 1985 MEDICARE ALLOWED CHARGES FOR MEDICAL SPECIALISTS AND RADIOLOGISTS[a]

Description	Actual Allowed Charge	PREDICTED AMOUNT		
		Without Pre/Post Time and Surg. Adj.[b]	With Pre/Post Time and Without Surg. Adj.[c]	With Pre/Post Time and Surg. Adj.[d]
Skin Biopsy (11100)	$40	$58 ($45-77)	$48 ($38-60)	$84 ($64-111)
Excision of benign lesion, trunk, arms, or legs; 1.1 to 2.0 cm (11402)	66	88 (75-103)	81 (70-95)	140 (111-176)
Diagnostic upper GI endoscopy (43235)	279	97 (81-116)	86 (72-102)	142 (113-179)
Upper GI endoscopy with biopsy (43239)	323	110 (90-134)	97 (80-116)	156 (124-197)
Complete skull x-ray, interpretation and report (70260)	22	21 (15-29)	18 (13-24)	15 (12-19)
Chest X-ray, single view, interpretation and report (71010)	13	17 (11-26)	13 (9-19)	12 (9-16)
Chest X-ray, two views, interpretation and report (71020)	14	20 (13-30)	16 (11-22)	14 (10-18)
Upper GI series interpretation and report (74240)	30	38 (31-47)	34 (28-42)	27 (23-32)
Cholecystography, oral contrast; interpretation and report (74290)	19	18 (13-25)	18 (13-25)	17 (13-22)
Initial comprehensive office visit for general practitioners (90020)	40	94 (75-116)	95 (79-113)	65 (55-76)
Initial comprehensive office visit for internist (90020)	61	127 (99-162)	130 (106-159)	85 (70-102)
Initial comprehensive office visit for cardiologist (90020)	65	111 (82-148)	119 (95-150)	81 (66-99)
Follow-up intermediate office visit for internist (90060)	25	43 (32-57)	46 (36-59)	37 (31-45)
Initial comprehensive hospital visit for cardiologist (90220)	68	120 (92-155)	125 (101-154)	83 (68-100)
Initial comprehensive consultation for internist (90620)	85	151 (119-193)	151 (123-185)	94 (77-115)
ECG interpretation and report (93010)	13	20 (14-28)	17 (13-23)	15 (12-19)
Echocardiography, real time (93307)	96	89 (75-106)	89 (67-94)	53 (45-62)
Combined left heart catheterization with angiography (93547)	606	214 (161-286)	183 (139-240)	258 (200-333)
Combined right and left heart catheterization with angiography (93549)	813	279 (204-381)	246 (182-331)	334 (256-435)
EEG (awake, asleep, and drowsy) interpretation and report (95819)	39	64 (47-88)	50 (39-66)	34 (28-43)

[a] 95 percent confidence limits in parentheses.

[b] Predictions based on regression model shown in column 1 in Table 4-5.

[c] Predictions based on regression model shown in column 2 in Table 4-5.

[d] Predictions based on regression model shown in column 3 in Table 4-5.

Note: Predicted amounts do not include any downward adjustment that may be necessary in order to preserve budget neutrality, or constant total outlays across all services and procedures.

Source: Actual Medicare allowed charges were obtained from 1985 BMAD claims data. Procedure time and complexity estimates were calculated from the Physicians' Practice Follow-up Survey.

the three basic specifications are shown in the columns 2 through 4. Under each predicted amount is the 95 percent confidence interval. One approach to identifying mispriced procedures is to consider those procedures in which the actual Medicare charge is greater (less) than the upper (lower) bound of the confidence interval as over (under) paid. Alternatively, one could set an arbitrary cut-off for the predicted amounts such as 30 percent greater or less than the actual allowed charge. However, this is a less statistically rigorous approach and therefore less preferable than the confidence interval method.

Predicted payment amounts which take into account procedure time and complexity only (col. 2, Table 5-1) are substantially higher than the actual payments for office and hospital visits. General practitioners would experience a 135 percent increase in payments for initial office visits, from $40 to $94. Payments to internists would rise slightly more than twofold to $127. Cardiologists would receive less dramatic increases, amounting to 70-75 percent, on both initial office and hospital visits.

The two endoscopies shown in Table 5-1 would be slashed by nearly two-thirds, although the upper GI endoscopy with biopsy would still be paid about 10 percent more than the endoscopy without biopsy. The two cardiac catheterization procedures would face similar cuts, but again the relative payment differences would be preserved under the regression-based payments, with the combined right and left heart catheterization still being paid about one-third more than the left heart catheterization.

The two skin procedures would be considered underpaid based on relative physician effort (col. 2, procedure time and complexity). The excision would rise by one-third, while the biopsy would increase by almost one-half.

The radiology procedures would be considered appropriately paid with one exception. The upper GI series (interpretation and report only) would appear to be slightly underpaid. (Note that the actual charge of $30 is just below the lower bound of the confidence interval.)

The addition of pre/post time to the regression equation has a relatively small effect on the predicted amounts (col. 3, Table 5-1). This is because only two procedures in the medical specialist equations actually include pre/post times (permanent pacemaker insertions).

The addition of a surgical adjustment, however, does dramatically alter the predicted amounts. (Surgical procedures include major OR procedures as well as invasive diagnostic procedures). Predicted payment amounts for visits drop sharply although they are still well above the current payment levels. For example, the internist's office visit currently is priced at $61. We noted above that based on procedure time and complexity alone, the payment would rise to $127. Including pre/post time (which of course equals zero for

.61). Of particular interest are the differences in the time and complexity coefficients between the regressions segmented based on physician specialty (cols. 3 and 6 of Table 4-5) and those segmented based on type of service (cols. 5 and 6 of Table 4-6). In the "medical services" equation, both time and complexity become less important in explaining fee variation, while the intercept rises sharply. By contrast, surgical time becomes considerably more important, increasing from .59 (Table 4-5) to .96. Moreover, operative complexity becomes relatively less important in explaining fees in a surgery-only regression. As will be shown in chapter 5, this will change relative predicted amounts for surgical procedures.

this service) and a surgical adjustment would lower payments for the visit to $85. Clearly, this service is still underpaid (by 39 percent), but not nearly as much as before. Comprehensive consultations provided by internists, on the other hand, appear to be appropriately reimbursed given the physician effort involved. Based on their self-reports, internists estimate that initial hospital visits (not shown in table) and consultations involve comparable levels of time and complexity, yet Medicare currently pays 44 percent more for the latter ($85 versus $59).

Four common diagnostic procedures appear considerably "overpaid" relative to physician effort (col. 4): skull x-ray, upper GI endoscopy (both diagnostic only and with biopsy), echocardiography, and cardiac catheterization with angiography (both combined right and left heart, and left heart only). Predicted payments would be about 50 percent lower than current Medicare payment levels. By contrast, current reimbursement rates for other common, but more routine services such as ECGs, EEGs, and chest x-rays appear to be equitably paid relative to the physician effort involved. Thus, inclusion of the surgical adjustment appears to identify more "outlier" medical procedures. However, the estimates appear to be more precise and reliable (because of the narrower confidence band).

5.2 Predicted Payments for Surgical Specialists

Table 5-2 presents predicted payment amounts for services commonly performed by surgical specialists. A number of the surgical procedures appear to be overpaid relative to the procedure time and complexity, as reported by physicians. Based on time and complexity alone (that is, without pre/post time and surgical adjustment), eight procedures would be paid considerably less under a regression-based approach: total hip replacement, pacemaker insertion (ventricular), cystourethroscopy with resection, TURP, cervical biopsy, one-stage lens procedure, tympanoplasty without mastoidectomy, and Swan-Ganz catheterization.

The predicted amounts on Table 5-2 permit some interesting observations about current Medicare fees for surgical procedures compared to their relative difficulty as perceived by surgeons. Interestingly, Medicare reimburses basically the same amount for an original hip replacement as for a revision, but the latter is considerably more time consuming and complicated. This is reflected in their regression-based payments. While allowed charges for hip replacements would be reduced by one-fourth, those for hip revisions would increase by nearly one-half. By contrast, Medicare currently pays almost 60 percent more for lens extraction plus intraocular lens insertion than for extraction alone. Yet ophthalmologists report that operating time for the one-stage procedure is only slightly longer and moderately more complex. Based on the physician effort involved, the one-stage procedure would still be paid more than extraction alone, but only 40 percent more.

TABLE 5-2

ACTUAL AND PREDICTED 1985 MEDICARE ALLOWED CHARGES FOR SURGICAL SPECIALISTS[a]

Description	Actual Allowed Charge	PREDICTED AMOUNT: Without Pre/Post Time and Surg. Adj.[b]	With Pre/Post Time and Without Surg. Adj.[c]	With Pre/Post Time and Surg. Adj.[d]
Adjacent tissue transfer: eyelids, nose, ears and/or lips (14060)	$524	$565 ($451-$707)	$876 ($694-$1,104)	$815 ($681-$976)
Total hip replacement (27130)	2,252	1,735 (1,340-2,245)	1,979 (1,593-2,458)	1,746 (1,476-2,066)
Secondary hip revision (27135)	2,271	3,584 (2,604-4,933)	3,105 (2,389-4,034)	2,701 (2,204-3,311)
Total knee replacement (27447)	2,196	1,876 (1,447-2,432)	2,034 (1,641-2,522)	1,827 (1,546-2,158)
Permanent transvenous pacemaker insertion; ventricular (33207)	1,058	332 (246-423)	675 (490-928)	608 (474-778)
Coronary artery bypass; three grafts (33512)	3,714	3,342 (2,332-4,789)	3,202 (2,388-4,294)	2,639 (2,099-3,318)
Carotid thromboendarterectomy (35301)	1,497	1,608 (1,229-2,104)	1,739 (1,392-2,172)	1,634 (1,375-1,942)
Cholecystectomy (47600)	798	1,009 (800-1,273)	1,308 (1,061-1,612)	1,239 (1,053-1,458)
Cystourethroscopy with resection of small bladder tumor (52234)	322	209 (178-245)	120 (99-146)	192 (156-237)
Transurethral resection of the prostate (52601)	1,038	640 (534-767)	1,040 (839-1,288)	959 (812-1,133)
Biopsy of cervix (cone) (57520)	264	51 (40-65)	54 (44-65)	87 (70-107)
Total hysterectomy (58150)	922	941 (762-1,162)	1,235 (1,016-1,502)	1,144 (983-1,332)
Craniectomy for excision of brain tumor (61510)	2,098	5,187 (3,643-7,386)	4,344 (3,249-5,809)	3,620 (2,886-4,540)
Extraction of lens; extracapsular (66940)	978	712 (511-992)	1,042 (774-1,403)	1,035 (821-1,305)
Extracapsular cataract removal with insertion of intraocular lens prosthesis (one stage procedure) (66984)	1,546	999 (703-1421)	1,235 (917-1,661)	1,236 (981-1,558)
Tympanoplasty without mastoidectomy (69631)	1,135	533 (392-724)	894 (663-1,205)	798 (633-1,007)
Ophthalmic ultrasound; A-mode (76516)	133	125 (96-163)	86 (68-110)	53 (43-65)
Initial comprehensive office visit for general surgeon (90020)	38	204 (174-239)	118 (98-144)	69 (57-83)
Initial comprehensive hospital visit for general surgeon (90220)	51	256 (219-300)	135 (109-167)	78 (64-96)
Swan-Ganz catheterization (93503)	245	83 (68-102)	70 (59-84)	115 (94-140)

[a] 95 percent confidence limits in parentheses.

[b] Predictions based on regression model shown in column 4 in Table 4-5.

[c] Predictions based on regression model shown in column 5 in Table 4-5.

[d] Predictions based on regression model shown in column 6 in Table 4-5.

Note: Predicted amounts do not include any downward adjustment that may be necessary in order to preserve budget neutrality, or constant total outlays across all services and procedures.

Source: Actual Medicare allowed charges were obtained from 1985 BMAD claims data. Procedure time and complexity estimates were calculated from the Physicians' Practice Follow-up Survey.

Several of the surgical procedures appear to be appropriately paid relative to the procedure time and complexity, most notably the three artery CABG and the carotid thromboendarterectomy. The cholecystectomy is actually underpaid by about one-fourth. As with the medical specialists, the visits are substantially underpaid. Both office and hospital visits performed by general surgeons would increase five-fold, with the office visit for example being paid over $200 (compared to $38 currently). This is consistent with the relatively high time and complexity estimates assigned to these services. Consider, for example, the initial office visit and a cystoruethroscopy with resection of a small bladder tumor. Both are reported to be of equal complexity and to take equal amounts of time to perform, yet Medicare currently pays 8 1/2 times more for this surgical procedure than for the visit. Based on the physician effort involved, however, both services would be reimbursed about the same ($200).

The <u>addition of pre/post time</u> to the regression equation has a demonstrable effect on predicted payment amounts, especially for ohpthalmology procedures. The one-stage lens procedure, previously overpaid by one-third, now appears to be appropriately paid when pre/post time is considered. Whereas the procedure itself takes about 45 minutes, pre/post time adds more than two hours. However, ophthalmic ultrasound would be considered overpaid when pre/post time is taken into account. Currently paid $133, the predicted payment would be 50 percent less at $86.

Of the seven procedures previously considered overpaid, only three remain overpaid when pre/post time is included in our measure of physician effort (pacemaker insertion, cystourethroscopy, and Swan-Ganz catheterization). Moreover, the total hysterectomy and adjacent tissue transfer become <u>underpaid</u> when pre/post time is included. (Both the secondary hip revision and the cholecystectomy remain underpaid.) Office and hospital visit reimbursement for general surgeons would more or less triple (compared to the five-fold increase prior to the addition of pre/post time).

What impact does the inclusion of the <u>surgical adjustment</u> make in these predicted payments? As expected, predicted payments for non-surgical services fall, although visits still appear "underpaid" by 50-80 percent. While predicted payments for relatively simple invasive procedures like biopsies increase, those for longer operating room procedures (e.g., CABGs) actually decline. This occurs because the predicting equation places a relatively lower weight on the surgeon's time, especially for pre and post-operative care, after adjusting for the 2.8 accross-the-board multiplier favoring surgical fees. At the same time, the 95 percent confidence limits associated with all the predicted payments narrow considerably. The net effect is to produce four additional "overpaid" surgical procedures: total hip replacement, total knee replacement, CABG surgery, and tympanoplasty.

Inclusion of the surgical adjustment in the predicting equation thus has the counter-intuitive result of identifying more "outlier" surgical procedures. Given the more precise and more reliable estimates produced by this equation (as evidenced by the narrower confidence band), however, these results are preferred. Therefore, in the following sections, predicted amounts from alternative specifications are compared to amounts derived with the surgical adjustment.

5.3 Comparison of Pooled Versus Separate Regressions

The predicted amounts shown in Tables 5-1 and 5-2 were derived from separate medical and surgical specialty regressions. Separate equations were estimated under the assumption that medical and surgical specialists were reporting x-rays, visits, and other procedures along a very different complexity scale. This assumption is borne out in the empirical work. Surgeons, for example, may view brain surgery as ten times more complex per minute than interpreting an x-ray, yet the fee difference could be 100-fold. Cardiologists, by contrast, may view heart catheterization as four times more complex than an x-ray but charge only ten times more, not forty, because their subjective complexity scale is less compressed than the surgeons's.

Nevertheless, Table 5-3 compares the predicted amounts derived from pooled versus separate regressions for our selected procedures. (Refer to Exhibit B-9 for the predicted amounts under a pooled regression for the full list of procedures.) In general, the pooled regression results in higher predicted amounts for the endoscopies and other relatively short surgical procedures. Although the diagnostic upper GI endoscopy is overpaid in both regressions, the pooled regression would result in a 15 percent higher payment. The Swan Ganz catheterization would be paid 77 percent more under a pooled regression than a separate regresion. These payment differences would appear to result from a more favorable treatment of diagnostic surgical procedures in the pooled regression than in the separate medical regression.

In only two cases, however, are different conclusions drawn depending on the specification. The one-stage lens procedure appears to be "appropriately" paid in the separate regression, but overpaid in the pooled regression. (Note that the actual Medicare allowed charge of $1,546 is just above the upper confidence limit of $1,507 in the pooled regression.) The explanation for this difference appears to lie in the width of the confidence intervals produced in the separate versus pooled regressions. Given the larger number of degrees of freedom, the confidence limits around the predicted payments are considerably narrower in the pooled regression. Take, for example, the lens

TABLE 5-3

COMPARISON OF PREDICTED AMOUNTS: POOLED VS. SEPARATE MEDICAL-SURGICAL REGRESSIONS[a]

Procedure	Actual Allowed Charge	PREDICTED AMOUNT Separate Regressions[b]	Pooled Regressions[c]
Skin Biopsy (11100)	$40	$84 ($64-111)	98 (80-120)
Excision of benign lesion, trunk, arms, or legs; 1.1 to 2.0 cm (11402)	66	140 (111-176)	136 (114-163)
Diagnostic upper GI endoscopy (43235)	279	142 (113-179)	164 (137-197)
Upper GI endoscopy with biopsy (43239)	323	156 (124-197)	177 (147-212)
Complete skull x-ray, interpretation and report (70260)	22	15 (12-19)	16 (13-20)
Chest X-ray, single view, interpretation and report (71010)	13	12 (9-16)	13 (10-17)
Chest X-ray, two views, interpretation and report (71020)	14	14 (10-18)	15 (11-19)
Upper GI series interpretation and report (74240)	30	27 (23-32)	28 (24-33)
Cholecystography, oral contrast; interpretation and report (74290)	19	17 (13-22)	19 (15-22)
Initial comprehensive office visit for general practitioners (90020)	40	65 (55-76)	66 (59-75)
Initial comprehensive office visit for internist (90020)	61	85 (70-102)	85 (74-99)
Initial comprehensive office visit for cardiologist (90020)	65	81 (66-99)	82 (71-95)
Follow-up intermediate office visit for internist (90060)	25	37 (31-45)	39 (35-44)
Initial comprehensive hospital visit for cardiologist (90220)	68	83 (68-100)	84 (72-97)
Initial comprehensive consultation for internist (90620)	85	94 (77-115)	94 (81-110)
ECG interpretation and report (93010)	13	15 (12-19)	17 (13-20)
Echocardiography, real time (93307)	96	53 (45-62)	54 (48-61)
Combined left heart catheterization with angiography (93547)	606	258 (200-333)	285 (231-351)
Combined right and left heart catheterization with angiography (93549)	813	334 (256-435)	365 (291-458)
EEG (awake, asleep, and drowsy) interpretation and report (95819)	39	34 (28-43)	36 (30-42)

[a] 95 percent confidence limits in parentheses.

[b] Predictions based on regression model shown in column 3 in Table 4-5.

[c] Predictions based on regression model shown in column 7 in Table 4-5.

Note: Predicted amounts do not include any downward adjustment that may be necessary in order to preserve budget neutrality, or constant total outlays across all services and procedures.

Source: Actual Medicare allowed charges were obtained from 1985 BMAD claims data. Procedure time and complexity estimates were calculated from the PHysicians' Practice Follow-up Survey.

TABLE 5-3 (continued)

COMPARISON OF PREDICTED AMOUNTS: POOLED VS. SEPARATE MEDICAL-SURGICAL REGRESSIONS[a]

		PREDICTED AMOUNT	
Description	Actual Allowed Charge	Separate Regressions[b]	Pooled Regressions[c]
Adjacent tissue transfer: eyelids, nose, ears and/or lips (14060)	$524	$815 ($681-$976)	825 (692-983)
Total hip replacement (27130)	2,252	1,746 (1,476-2,066)	1,707 (1,456-2,002)
Secondary hip revision (27135)	2,271	2,701 (2,204-3,311)	2,566 (2,147-3,067)
Total knee replacement (27447)	2,196	1,827 (1,546-2,158)	1,775 (1,515-2,079)
Permanent transvenous pacemaker insertion; ventricular (33207)	1,058	608 (474-778)	728 (597-888)
Coronary artery bypass; three grafts (33512)	3,714	2,639 (2,099-3,318)	2,537 (2,077-3,098)
Carotid thromboendarterectomy (35301)	1,497	1,634 (1,375-1,942)	1,586 (1,344-1,871)
Cholecystectomy (47600)	798	1,239 (1,053-1,458)	1,226 (1,049-1,433)
Cystourethroscopy with resection of small bladder tumor (52234)	322	192 (156-237)	178 (148-213)
Transurethral resection of the prostate (52601)	1,038	959 (812-1,133)	972 (832-1,136)
Biopsy of cervix (cone) (57520)	264	87 (70-107)	85 (70-104)
Total hysterectomy (58150)	922	1,144 (983-1,332)	1,136 (980-1,318)
Craniectomy for excision of brain tumor (61510)	2,098	3,620 (2,886-4,540)	3,421 (2,804-4,174)
Extraction of lens; extracapsular (66940)	978	1,035 (821-1,305)	1,034 (837-1,277)
Extracapsular cataract removal with insertion of intraocular lens prosthesis (one stage procedure) (66984)	1,546	1,236 (981-1,558)	1,214 (977-1,507)
Tympanoplasty without mastoidectomy (69631)	1,135	798 (633-1,007)	815 (651-1,022)
Ophthalmic ultrasound; A-mode (76516)	133	53 (43-65)	49 (42-56)
Initial comprehensive office visit for general surgeon (90020)	38	69 (57-83)	62 (55-70)
Initial comprehensive hospital visit for general surgeon (90220)	51	78 (64-96)	70 (62-79)
Swan-Ganz catheterization (93503)	245	115 (94-140)	203 (169-244)

a
95 percent confidence limits in parentheses.

b
Predictions based on regression model shown in column 6 in Table 4-5.

c
Predictions based on regression model shown in column 7 in Table 4-5.

Note: Predicted amounts do not include any downward adjustment that may be necessary in order to preserve budget neutrality, or constant total outlays across all services and procedures.

Source: Actual Medicare allowed charges were obtained from 1985 BMAD claims data. Procedure time and complexity estimates wre calculated from the Physicians' Practice Follow-up Survey.

extraction without IOL insertion: the predicted amounts are just one dollar apart in the two regressions, but the confidence intervals around those amounts are $484 and $440 in the separate and pooled equations, respectively. This same factor accounts for the different results for the initial hospital visit by a cardiologist. Whereas the predicted amounts are $83-$84, the confidence interval is narrower in the pooled regression, leading to the conclusion that this service is underpaid.

The pooled regression has a major advantage over the separate medical-surgical equations. Where the two specialty groups perform procedures in common, only one predicted amount is produced, rather than two. These predicted amounts for common procedures can vary across the two equations producing conflicting results. Of the 21 procedures common to both the medical and surgical equations, seven yielded different results for surgical versus medical specialists. (See Table 5-4.) For comparison purposes, predicted amounts are also shown based on the pooled regression. As an example, one of the colonoscopies (beyond splenic flexure) was considered overpaid in the medical regression, but appropriately paid in the surgical regression. It is worth noting that the pooled regression concurs with the results from the medical regression, suggesting that the colonoscopy may indeed be overpaid.

Five of the procedures on the list are radiologic services. Three of the radiology procedures are overpaid in the medical regression and appropriately paid in the surgical regression, while two are overpaid only in the surgical regression. Only the skull x-ray was overpaid in the pooled regression.

5.4 Predicted Amounts Under Alternative Specifications

Three alternative regression analyses were performed for comparative purposes. First, we examined the effect on predicted payment amounts of a "time-only" regression. Next, we compared the results obtained with a single versus dual surgical adjustment, which distinguishes major operating room procedures from invasive diagnostic surgical procedures. Finally, we segmented the sample by type of service rather than by specialty. Tables 5-5 and 5-6 present the predicted amounts under these alternative specifications for medical and surgical specialists respectively. For comparison purposes, we also show the predicted amounts for our "preferred model" which includes procedure time, pre/post time, complexity, and surgical adjustment. The reader is referred to Appendix B (Exhibits B-10 through B-15) for predicted amounts under alternative specifications, for all procedures included in the study.

TABLE 5-4

PROCEDURES FOR WHICH DIFFERENT RESULTS ARE OBTAINED IN SEPARATE MEDICAL-SURGICAL REGRESSIONS

	MEDICAL SPECIALISTS[a]		SURGICAL SPECIALISTS[b]		POOLED MEDICAL-SURGICAL SPECIALISTS[c]	
Procedures	Actual Allowed Charge	Predicted Amount	Actual Allowed Charge	Predicted Amount	Actual Allowed Charge	Predicted Amount
Excision of benign lesion on trunk, arms, or legs -- 1.0 to 2.0 cm (11402)	$66	$140 ($111-$176)	$76	$94 ($73-$122)	$70	$136 ($114-$163)
Diagnostic, fiberoptic colonoscopy beyond the splenic flexure (45378)	391	247 (189-323)	362	322 (244-425)	383	276 (244-341)
Interpretation and report (only) for a complete sinus X-ray with a minimum of three views (70220)	18	13 (10-17)	17	14 (10-19)	18	14 (11-18)
Interpretation and report (only) for a complete skull X-ray with a minimum of four views (70260)	22	15 (12-19)	21	20 (15-27)	22	16 (13-20)
Interpretation and report (only) for a chest X-ray with two views (71020)	14	14 (10-18)	13	19 (14-25)	14	15 (11-19)
Interpretation and report (only) for a complete hip X-ray -- unilateral, with a minimum of two views (73510)	16	12 (9-15)	16	17 (12-24)	16	13 (10-16)
Interpretation and report (only) for an EEG -- awake, drowsy, and asleep (95819)	39	34 (28-43)	33	52 (39-70)	39	36 (30-42)

[a]Predictions based on regression model shown in column 3 in Table 4-5.

[b]Predictions based on regression model shown in column 6 in Table 4-5.

[c]Predictions based on regression model shown in column 7 in Table 4-5.

Note: Predicted amounts do not include any downward adjustment that may be necessary in order to preserve budget neutrality, or constant total outlays across all services and procedures.

Source: Actual Medicare allowed charges were obtained from 1985 BMAD claims data. Procedure time and complexity estimates were calculated from the Physicians' Practice Follow-up Survey.

TABLE 5-5

ACTUAL AND PREDICTED 1985 MEDICARE ALLOWED CHARGES FOR MEDICAL SPECIALISTS AND RADIOLOGISTS: ALTERNATIVE SPECIFICATIONS[a]

Description	Actual Allowed Charge	PREDICTED AMOUNT: With Pre/Post Time and Surg. Adj.[b]	Time Only[c]	Dual Surgical Adjustment[d]	Type of Service[e]
Skin Biopsy (11100)	$40	$84 ($64-111)	$43 (35-54)	$85 (66-110)	$75 (56-100)
Excision of benign lesion, trunk, arms, or legs; 1.1 to 2.0 cm (11402)	66	140 (111-176)	89 (75-106)	121 (95-153)	140 (115-172)
Diagnostic upper GI endoscopy (43235)	279	142 (113-179)	86 (72-102)	129 (103-161)	168 (136-206)
Upper GI endoscopy with biopsy (43239)	323	156 (124-197)	94 (79-113)	142 (113-178)	187 (151-231)
Complete skull x-ray, interpretation and report (70260)	22	15 (12-19)	19 (14-28)	18 (14-22)	20 (16-24)
Chest X-ray, single view, interpretation and report (71010)	13	12 (9-16)	14 (9-21)	15 (11-20)	16 (13-21)
Chest X-ray, two views, interpretation and report (71020)	14	14 (10-18)	16 (10-24)	17 (13-22)	18 (15-23)
Upper GI series interpretation and report (74240)	30	27 (23-32)	39 (31-49)	28 (24-33)	30 (27-35)
Cholecystography, oral contrast; interpretation and report (74290)	19	17 (13-22)	27 (20-37)	16 (13-21)	22 (18-25)
Initial comprehensive office visit for general practitioners (90020)	40	65 (55-76)	119 (97-146)	59 (50-69)	59 (54-66)
Initial comprehensive office visit for internist (90020)	61	85 (70-102)	161 (126-206)	75 (62-91)	73 (64-82)
Initial comprehensive office visit for cardiologist (90020)	65	81 (66-99)	164 (128-210)	68 (55-85)	56 (51-62)
Follow-up intermediate office visit for internist (90060)	25	37 (31-45)	70 (59-84)	32 (26-40)	39 (35-43)
Initial comprehensive hospital visit for cardiologist (90220)	68	83 (68-100)	161 (126-205)	72 (59-88)	71 (63-81)
Initial comprehensive consultation for internist (90620)	85	94 (77-115)	175 (135-227)	85 (70-104)	79 (69-90)
ECG interpretation and report (93010)	13	15 (12-19)	20 (14-29)	17 (14-22)	20 (16-24)
Echocardiography, real time (93307)	96	53 (45-62)	82 (69-97)	55 (47-64)	51 (46-57)
Combined left heart catheterization with angiography (93547)	606	258 (200-333)	157 (123-200)	236 (185-303)	375 (284-497)
Combined right and left heart catheterization with angiography (93549)	813	334 (256-435)	217 (161-293)	292 (225-380)	553 (395-775)
EEG (awake, asleep, and drowsy) interpretation and report (95819)	39	34 (28-43)	43 (34-54)	41 (32-53)	37 (32-44)

a
95 percent confidence limits in parentheses.

b
Predictions based on regression model shown in column 3 in Table 4-5.

c
Predictions based on regression model shown in column 1 of Table 4-6.

d
Predictions based on regression model shown in column 3 of Table 4-6.

e
Predictions based on regression model shown in column 5 in Table 4-6.

Note: Predicted amounts do not include any downward adjustment that may be necessary in order to preserve budget neutrality, or constant total outlays across all services and procedures.

Source: Actual Medicare allowed charges were obtained from 1985 BMAD claims data. Procedure time and comlexity estimates were calculated from the Physicians' Practice Follow-up Survey.

TABLE 5-6

ACTUAL AND PREDICTED 1985 MEDICARE ALLOWED CHARGES FOR SURGICAL SPECIALISTS: ALTERNATIVE SPECIFICATIONS[a]

Description	Actual Allowed Charge	PREDICTED AMOUNT			
		With Pre/Post Time and Surg. Adj.[b]	Time Only[c]	Dual Surgical Adjustment[d]	Type of Service[e]
Adjacent tissue transfer: eyelids, nose, ears and/or lips (14060)	$524	$815 ($681-$976)	$833 ($667-$1,040)	$911 ($759-$1,093)	$821 ($655-$1,030)
Total hip replacement (27130)	2,252	1,746 (1,476-2,066)	1,838 (1,369-2,468)	1,693 (1,445-1,984)	1,941 (1,607-2,346)
Secondary hip revision (27135)	2,271	2,701 (2,204-3,311)	3,380 (2,358-4,846)	2,463 (2,023-2,997)	3,343 (2,628-4,252)
Total knee replacement (27447)	2,196	1,827 (1,546-2,158)	1,689 (1,269-2,249)	1,760 (1,504-2,060)	1,982 (1,650-2,381)
Permanent transvenous pacemaker insertion; ventricular (33207)	1,058	608 (474-778)	612 (500-748)	696 (544-890)	664 (510-865)
Coronary artery bypass; three grafts (33512)	3,714	2,639 (2,099-3,318)	4,670 (3,140-6,945)	2,397 (1,923-2,988)	3,524 (2,626-4,729)
Carotid thromboendarterectomy (35301)	1,497	1,634 (1,375-1,942)	1,137 (887-1,457)	1,611 (1,370-1,894)	1,635 (1,341-1,994)
Cholecystectomy (47600)	798	1,239 (1,053-1,458)	759 (612-941)	1,268 (1,087-1,480)	1,152 (957-1,388)
Cystourethroscopy with resection of small bladder tumor (52234)	322	192 (156-237)	238 (199-286)	368 (242-559)	204 (165-253)
Transurethral resection of the prostate (52601)	1,038	959 (812-1,133)	645 (526-791)	1,011 (862-1,187)	874 (726-1,053)
Biopsy of cervix (cone) (57520)	264	87 (70-107)	66 (50-86)	78 (64-96)	72 (56-92)
Total hysterectomy (58150)	922	1,144 (983-1,332)	1,045 (822-1,330)	1,203 (1,039-1,393)	1,171 (989-1,387)
Craniectomy for excision of brain tumor (61510)	2,098	3,620 (2,886-4,540)	4,484 (3,029-6,638)	3,079 (2,449-3,871)	4,583 (3,500-6,000)
Extraction of lens; extracapsular (66940)	978	1,035 (821-1,305)	351 (293-420)	1,073 (861-1,336)	805 (586-1,105)
Extracapsular cataract removal with insertion of intraocular lens prosthesis (one stage procedure) (66984)	1,546	1,236 (981-1,558)	467 (387-564)	1,263 (1,015-1,571)	1,020 (746-1,397)
Tympanoplasty without mastoidectomy (69631)	1,135	798 (633-1,007)	1,052 (826-1,339)	890 (709-1,118)	850 (621-1,164)
Ophthalmic ultrasound; A-mode (76516)	133	53 (43-65)	87 (68-110)	51 (42-62)	47 (41-54)
Initial comprehensive office visit for general surgeon (90020)	38	69 (57-83)	232 (193-278)	65 (54-78)	59 (54-66)
Initial comprehensive hospital visit for general surgeon (90220)	51	78 (64-96)	278 (233-333)	73 (60-88)	62 (56-69)
Swan-Ganz catheterization (93503)	245	115 (94-140)	93 (74-118)	100 (82-122)	242 (194-301)

[a] 95 percent confidence limits in parentheses.

[b] Predictions based on regression model shown in column 6 in Table 4-5.

[c] Predictions based on regression model shown in column 2 of Table 4-6.

[d] Predictions based on regression model shown in column 4 of Table 4-6.

[e] Predictions based on regression model shown in column 6 in Table 4-6.

Note: Predicted amounts do not include any downward adjustment that may be necessary in order to preserve budget neutrality, or constant total outlays across all services and procedures.

Source: Actual Medicare allowed charges were obtained from 1985 BMAD claims data. Procedure time and complexity estimates were calculated from the Physician's Practice Follow-up Survey.

5.4.1 Time-Only Regression-Based Payments

The Medicare price regressions were re-estimated as before, for surgical and medical specialists separately, but this time omitting the complexity measure, pre/post time, and surgical adjustment. Payments based on procedure time alone are considerably higher for several surgical procedures, notably CABG surgery, craniectomy, and tympanoplasty. A three-artery CABG, for example, would be paid $4,670 under a time-only payment system, that is, 25 percent more than the current payment. Taking into account complexity and other factors, however, the payment would be $2,639 -- a 29 percent reduction. When time alone is considered in the payment methodology, it is overvalued relative to the complexity of the procedure. Visit reimbursement is also raised substantially with general surgeons receiving $232 for an initial office visit, and $278 for an initial hospital visit (compared to $69 - $78 in the preferred model).

Similarly, office and hospital visits performed by medical specialists would be paid considerably more if time alone were a factor in the reimbursement system, with cardiologists being paid $164 for an initial office visit, about twice the amount under our "preferred model" ($81). In contrast, such diagnostic procedures as cardiac catheterizations and upper GI endoscopies, would be paid even less under a time only approach, suggesting that these procedures are relatively quick to perform, but also relatively complex. Moreover, in our "preferred model" they benefit from the surgical adjustment. The next section examines the impact of a dual surgical adjustment on payments for these procedures.

5.4.2 Dual Surgical Adjustments for Major vs. Minor Procedures

The dummy surgical adjustment variable used in previous analyses treats all surgical procedures as if they were the same. In fact, however, "surgery" as used by Medicare includes a wide range of services, including diagnostic procedures like endoscopies and cardiac catheterizations, relatively minor therapeutic procedures, such as excisions of benign lesions, and of course major operating room procedures like prostatectomies and CABGs. From earlier regression results, we observed that this single dummy approach to surgical adjustment had the effect of increasing predicted amounts for endoscopies and other diagnostic procedures as compared to the amounts derived from a regression without the surgical adjustment (Recall Table 5-1).

Column 4 of Table 5-5 presents predicted amounts for medical specialists based on the dual surgical adjustment. Predicted amounts for minor surgical procedures are indeed lower with the dual adjustment, but only by about 10

percent. The upper GI endoscopy with biopsy, which would be paid $156 with the single adjustment, would receive $142 with a dual adjustment. The cardiac catheterizations are reduced similarly. Payments for visits would either fall slightly or stay the same.

In the surgeons' equation (Table 5-6), one of the "major" surgeries, cystourethroscopy, would receive a large payment increase, moving from the "overpaid" to the "appropriately" paid category. Otherwise, the results are very similar, regardless of whether a single or dual adjustment is made. In part, this is due to the effect of including pre/post time for major surgery but not for minor surgery. Such an adjustment is therefore captured in the coefficient for the pre/post time.

5.4.3 Segmenting the Sample Based on Type of Service

In previous analyses, the sample was segmented into two groups: (1) services provided by surgical specialists; and (2) services provided by medical specialists. This was done on the grounds that their relative fee structures based on time and complexity might be incomparable, particularly if, as we suspect, the two groups used implicitly different scales to rank complexity. It is possible, however, that the different types of services are so heterogeneous that separate regressions should be estimated for surgery, radiology, visits, etc.

We do not have sufficient observations to estimate equations separately for each type of service, but we did estimate a regression for all surgical procedures, and another for all other services. These predicted amounts are shown in the last column of Tables 5-5 and 5-6. Although the procedures are listed on these two tables according to specialty group, the regressions were segmented by type of service. Among the surgical procedures performed by medical specialists, we find considerable increases in some of the predicted amounts, as they benefit from inclusion with other surgical procedures reported by surgeons. For example, the right and left heart catheterization would increase from $334 to $553 -- a 66 percent jump. Payments for major surgical procedures, performed by surgeons, would also increase, some by substantial percentages. In fact, five of the "overpriced" surgical procedures no longer appear to be overpriced: total hip replacement, total knee replacement, CABG, tympanoplasty, and Swan-Ganz catheterization. The reason for this appears to lie in the relative importance of procedure time in the equation. Compared to pre/post time and complexity, procedure time takes on greater importance in this equation than in our "preferred model." This also explains why the one-stage lens procedure now appears to be overpaid when the procedures are segmented by type of service. Similarly, the secondary hip revision would be classified as underpaid based on this specification.

Visits are little affected by this specification. they still appear to be underpaid, but not by quite as large a percentage. Office visits by general surgeons would be paid $10 less under the "type of service" model, decreasing from $69 to $59. Similar reductions would occur among medical specialists. Predicted amounts for radiology services, on the other hand, would increase slightly but most would still appear to be appropriately paid. The chest x-ray with two views, however, would now be considered just slightly underpaid.

6.0 SUMMARY AND CONCLUSIONS

One way to evaluate the "inherent reasonableness" of physician fees for various services is to compare them with the level of effort involved. Based on a 1987 national survey of physicians in 18 specialties, we obtained estimates of the time and complexity of a wide range of services, including major and minor surgery, visits, and x-rays. Physician respondents appeared willing and able to provide reliable, valid estimates of these two dimensions of effort. Average time and complexity scores were internally consistent (e.g., initial office visits for a new patient are longer and more complex than a follow-up visit) and had face validity. That is, relative times and complexity rankings were consistent with what we would expect from a clinical viewpoint. Furthermore, inter-rater reliability appeared to be high in these estimates. There was a high level of agreement among physicians in the time and complexity values they assigned to each procedure.

In order to identify those procedures whose payments appear most "out of line" given the level of physician effort involved, we developed a regression model that used time and complexity to explain actual Medicare allowed charges. This model is based on the assumption that <u>on average</u>, across <u>all</u> services, Medicare payments adequately reflect physician effort. (The very notion that some procedures are "overpriced" makes the same assumption.)

Predicted payment amounts have been derived from a model that takes into account procedure time and complexity, pre/post time (where applicable), and whether the procedure is surgical or non-surgical. Regressions were estimated separately for medical and surgical specialists, because of concern that these two groups of physicians implicitly used different complexity scales (Table 4-5, cols. 3 and 6).

Our regression results have shown that the majority of the variation in Medicare payment can be explained by the physician effort associated with providing different services and procedures -- particularly if a special allowance is made for surgery. This implies that <u>relative</u> fee differences are less distorted than commonly thought. That is, the fact that thoracic surgeons are paid more for CABGs than general surgeons are for hysterectomies can be largely explained by the greater time and complexity of bypass surgery. Similarly, based on surgeons' self-reports, higher payments for surgery than for visits can be justified by the more intense effort involved.

Nevertheless, a number of services and procedures have been identified that appear to be under- or overpaid. (See Table 6-1.) Over (under) paid procedures were defined as those in which the actual Medicare allowed charge was greater (less) than the upper (lower) bound of the 95 confidence interval around the predicted amount. In previous work, we considered procedures as

TABLE 6-1

SUMMARY OF OVER-, AND UNDER-PAID PROCEDURES[a]

"OVERPAID" PROCEDURES

Total hip replacement
Total knee replacement
Operative laryngoscopy
Permanent pacemaker insertion, both single and dual chamber
Coronary artery bypass graft (CABG) surgery
Upper GI endoscopy
Cystourethroscopy with fulgulation or resection of small bladder tumor
Biopsy of cervix
Tympanoplasty
Nerve conduction, velocity and/or lateney study (motor)
Lithotripsy
Laser photocoagulation
Abdominal echography
Ophthalmic ultrasound, A-mode and B-scan
Initial hospital visits by ENT and plastic surgeons
Consultations by plastic surgeons
Echocardiography, M-mode and real-time
Swan-Ganz catheterization
Left heart and combined right and left heart catheterization with angiography

"UNDERPAID" PROCEDURES

Skin biopsy
Excisions of benign lesions
Destruction of facial lesion
Adjacent tissue transfer or rearrangement on face
Split graft of trunk, arms, legs, hands or feet
Modified radical mastectomy
Total abdominal hysterectomy
Vaginal hysterectomy with plastic repair
Major joint arthrocentesis
Femoral fracture with interal fixation
Intertrochanteric or pertrochantric femur fracture with internal fixation
Control nasal hemmorhage
Partial colectomy
Lung lobectomy
Inguinal hernia repair
Diagnostic upper GI endoscopy, complex with biopsy
Diagnostic flexible fiberoptic sigmoidoscopy
Proctosigmoidoscopy
Cholecystectomy with and without common duct exploration
Dilation of female urethra
Endometrial biopsy

TABLE 6-1 (continued)

SUMMARY OF OVER-, AND UNDER-PAID PROCEDURES[a]

"UNDERPAID" PROCEDURES (continued)

Craniectomy for evacuation of hematoma and for excision of brain tumor
Lumbar puncture
Lumbar laminectomy
Hemilaminectomy
Fistulization of sclera
Scleral buckling
Initial office visits by GPs, FPs, neurologists, cardiologists, dermatologists, gastroenterologists, internists, urologists OB-GYNs, general, orthopedic, cardiovascular/thoracic, and neurosurgeons
Initial hospital visits by GPs, FPs, neurologists, OB-GYNs, general, orthopedic, and neurosurgeons
Intermediate follow-up office and hospital visits for GPs, FPs, dermatologists and internists
Discharge hospital visits for GPs, FPs, and internists
New patient visit by ophthalmologists
Serial tonometry

[a]Over(under) paid procedures were defined as those in which the actual Medicare allowed charge was higher (lower) than the 95 percent confidence interval around the predicted amount. Predicted amounts were derived from regressions including procedure time, pre/post time, complexity, and surgical adjustment, and were estimated for medical and surgical specialists separately.

Source: Actual Medicare allowed charges were obtained from 1985 BMAD claims data. Simulated payments were based on procedure time and complexity estimates reported in the 1987 Physicians' Practice Follow-up Survey.

over (under) paid when the actual Medicare allowed charge was at least 30 percent greater (lower) than the predicted amount. We have chosen the confidence interval approach because we believe it provides a more statistically rigorous and reliable method of producing a list of under- and overpaid procedures.

Surgical procedures that appear to be overpaid include hip and knee replacements, CABGs, permanent pacemaker insertions, and upper GI endoscopies, among others. Also included on the "overpaid list" are a number of diagnostic services frequently performed on the elderly, such as cardiac catheterization, echocardiography, and ophthalmic ultrasound scans. By contrast, both initial office and hospital visits would appear to be "underpaid" for a number of specialties and would be reimbursed at substantially higher levels. This of course, is consistent with the criticism by many medical specialists that Medicare "underpays" for non-procedural ("cognitive") services. A number of high volume surgical procedures also appear "underpaid" given their reported time and complexity, such as excision of benign skin lesions, mastectomy, proctosigmoidoscopy, partial colectomy, and cholecystectomy with and without exploration.

Congress has reduced the Medicare prevailing charges for a number of surgical procedures believed to be "overpaid", including some also identified by our regression methodology: coronary artery bypass surgery, pacemaker insertion, total hip and knee replacements, and upper GI endoscopy. When these procedures were first developed, their high fees may well have been appropriate given their newness and surgeons' inexperience with them. Over time, technological advances and "learning by doing" undoubtedly have made them easier and quicker to perform, yet fees have remained high (Bowen, 1987; Mitchell, et al., 1987b). Indeed, since the UCR method of reimbursement bases payments on submitted charges, the incentive has been to continually increase fees rather than to lower them.

Based on reported physician effort, however, other procedures that also were rolled back by Congress do not appear "overpaid" in relation to time and complexity. These include cataract surgery and prostatectomy, whose actual allowed charges fell within the confidence limits of our predictions, albeit still roughly ten percent above their expected amounts. The reason appears to lie primarily in the relatively long pre and postoperative times reported for these operations. Ophthalmologists report that lens procedures require relatively little time in the operating room (less than one hour), but that they spend almost three times as long in preoperative and follow-up care. In the regressions that included only operating time, both cataract surgery and prostatectomies appeared considerably "overpaid". Since surgeons report that their pre and postoperative care is usually part of their global fee, however,

it must be considered as part of the total effort associated with a procedure. Yet, the Congress considered only operating room times in justifying payment reductions. Future deliberations on fee rollbacks should consider any extraordinary time involved in pre and postoperative care, but our results indicate that non-operating time is valued at only one-third the rate of procedure time. And because non-operating time plays such an important role in explaining allowed charges, it will be crucial to measure such time input as accurately as possible, as well as the extent to which this time remains bundled in the global surgical fee.

A few caveats should be noted. First, any adjustments to the current payment system for a few over- or underpaid procedures would require an across-the-board reduction to achieve budget neutrality. Our predicted payment amounts do not take account of budget neutrality considerations. Second, our predicted payment amounts do not take into account other factors that might affect fees besides the complexity of the procedure and the time it takes to perform and to provide follow-up care. Visits, for example, may involve more non-physician time, and this effort was not included in our regression methodology. To the extent that office visits require more nurse or aide time, as well as other overhead inputs, they will be even more underpaid relative to operations. Even among surgical procedures, practice costs may differ. General surgeons and gynecologists performing hysterectomies, for example, face higher malpractice premiums than do ophthalmologists doing lens extractions, yet predicted payments based on time and complexity are comparable for both operations.

Our final caveat concerns the interpretation of the "predicted payment amounts" derived from the regression methodology. Our intent in this study has been to identify high volume, high dollar Medicare procedures in which the current Medicare allowed charge is too high or too low relative to physician effort. The predicted amounts shown in Chapter 5 and Appendix B should not be considered a fee schedule. Moreover, predicted payments obtained from our regression results should be viewed as relative, not absolute dollar amounts. Predicted Medicare payments of $1,769 and $2,686 for hip replacement and secondary hip revision, for example, imply that the more complex revision should be paid at a rate about 50 percent higher, but they do <u>not</u> necessarily mean that $2,686 is the societally desired price for this surgery.

We close with two recommendations for future research. Clearly, pre/post operative time plays an important role in explaining higher surgical fees, but it is not valued as highly in the market as procedure time. Therefore, if pre/post time were simply added to procedure time, the effort involved in many surgical procedures would be overstated by implicitly assuming an equal value to physician time in the operating room and

elsewhere. Moreover, because pre/post time appears to be so important in justifying fees for some kinds of surgery, researchers should obtain careful, accurate measures of it, ideally through independent observation, and also assess the extent to which this time remains bundled in the global surgical fee.

A closely related issue for future consideration is whether to make a separate adjustment to fees for surgery. Our results indicate that surgical procedures are 2 1/2 to 3 times more expensive than medical services of equivalent time and complexity. Patient willingness to pay more for surgical intervention, longer training residencies, and higher malpractice costs may all be legitimate explanations for this surgery payment premium. On the other hand, any insurance bias in favor of surgery may have distorted fees in ways that are neither efficient nor equitable. How one evaluates this large unexplained surgical differential would have profound implications for the number of overpriced surgical procedures. Careful study is required to determine whether extra training and practice costs associated with doing surgery can justify a 2-3 fold premium. If not, then an across-the-board rollback in surgical payments would be warranted.

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